Assessing Health Games in Secondary Schools:

An Investigation of the American Horsepower Challenge 2009-2010

Technical Report

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Executive Summary

In this executive summary, we highlight the most impactful results of our independent evaluation of a three-semester, nationwide development of the American Horsepower Challenge (AHPC), a game for K-12 settings that addresses trends in youth physical activities and computer-based social play.

AHPC as a Facilitator of Child Behavior Change

Compared to the pedometer data collected one week before the AHPC was deployed, the participants logged significantly more steps during the three heats as compared to the pre-game period. In particular, the number of website logins was strongly (positively) correlated with the steps, implying a relationship between involvement with the AHPC system and physical activity level. The students who collected more steps tended to log in the website more frequently. Although the activity of logging into the website itself did not increase the step number directly, it was an indicator of the involvement level with the Challenge.

Overall, students described being motivated to participate in AHPC to have fun, be healthier, and to support a sense of school pride. AHPC, in a sense, became a like other team sports in the school, except that the barriers to participation and success in the "sport" were removed. The students reported that they changed their behaviors, making conscious choices to walk more than they had previously, as well as trying new activities to increase their step counts. The students accumulated significantly more steps during weekdays than on weekends, indicating the important role the school environment and peer influence may play in this context. Although students would be expected to have more free time on weekends, they had more steps during the weekdays, indicating that there still is a larger space for increasing activity levels during weekends.

With these results in mind, it's important to note that schools used a variety of student selection processes including 1) randomly choosing students; 2) enrolling all students in a class or grade; 3) choosing the students who returned permission slips first; 4) choosing the most responsible students; 5) choosing the most enthusiastic students; or 6) choosing the most athletic students. The wide variety of student recruitment practices at the schools poses a problem in that the student samples differ

accordingly. If only the most responsible or enthusiastic students were chosen the odds are that our findings regarding long-term participation could be inflated. Also, if students were chosen based on already being “active”, there might be reason to believe that the AHPC would not impact their activity level much or change it over time (due to a ceiling effect).

The prize money offered to well-performing schools was both a boon and a curse: On the positive side, it seems to have motivated teachers to become more involved with the Challenge. On the negative side, the possibility of winning the prize money might have encouraged the teachers or administrators to select students who were already very active physically, and therefore unlikely to benefit much from an initiative like the AHPC. Anecdotally, our experience in the site visits suggested that the biggest advantage of the program was to include students who are not already on a sports team or physically active.

AHPC and Family Behavior Change

When it comes to supporting the children in being physically active, most parents seemed to be supportive, specifically by encouraging them to be physically active or play sports, transporting them to places where they can be physically active, or by joining them for physical activities. It was far more common for the parents to be verbally supportive than to actually do physical activities or play sports with their children. About half of the parents had paid for their children to take lessons relating to physical activities or so they could participate in organized physical activities or play sports. As the Challenge progressed, we found a drop in family support for being physically active, both in terms of family members joining the students in doing physical activities and encouraging them to be active. A possible reason for this is that the excitement about joining the AHPC in the beginning translated into more participation and encouragement from family members, but as the AHPC continued the “newness” and enthusiasm dropped off along with family involvement.

Integrating the Game into the School: The AHPC Teacher Is Crucial to the Game’s Success

The teacher plays a critical role in supporting the program within a given school. Teachers in the Challenge provided structured opportunities for additional physical activity, such as building walking into their class lessons, organizing after-school intramural competitions, or getting students access to the

school gym at times in which they normally would not be able to use it. The teachers also became stewards of the pedometers, and mediators between the school, the students, and Humana. The success of implementing the AHPC in a school is highly dependent on the teacher's enthusiasm and ingenuity in integrating the Challenge into existing school schedules. We recommend providing teachers with suggestions of how to include AHPC into classroom and extracurricular activities.

A related issue is that the AHPC as such does not impose any specific events on participants; it's up to them to get steps and log onto the website. Given the highly structured nature of a secondary school day, this might create a higher threshold for participation, as the students have to be especially enthusiastic to create the time and space to participate. Here again, helping teachers integrate the Challenge into their schedule could be the solution.

Designing Games for Schools: Information Technology Resources are Limited

Across the schools we visited, we found that computers within the schools were typically older (5-10 years old) and Internet connectivity was slow. The computers most available to students, such as computers in classrooms, tended to be the worst quality. We recommend designing future web-based interventions with older technology in mind. While there may be higher quality computers in the school, we observed that these computers were typically located in a dedicated lab separate from the teacher's classroom. It's important to recognize that access to lab computers requires extra work on the part of the teacher to ensure that the lab is available during a class period, and that the computer lab activities integrate well (rather than disrupt) existing lesson plans.

Game Design Recommendation: Implement Workarounds for Expected Hardware Failure

Students and teachers alike reported that maintaining enthusiasm was difficult in the face of repeated problems with the technology involved. Our findings suggest that the biggest problem was due to steps not being logged accurately (or at all). According to the teachers, nothing killed student enthusiasm faster than if the steps the students had worked at accumulating were not logged (for example due to malfunction in the Actiped). In addition, if the teachers were faced with having to spend time and effort solving technology problems (e.g. replacing Actipeds, getting the remote access point to work, or troubleshooting access to the AHPC website) their enthusiasm for participating decreased. We suggest

either providing more robust pedometers, or at the least, a way to manually input data that the pedometer “lost”. In order to sustain long-term interest, we especially recommend simplifying the website, and providing clarity to how step-counts are recorded by the game, so that students are not disappointed by perceived inaccuracies of the game.

Introduction

In the past 30 years, children and teens have adopted increasingly sedentary lifestyles. As of 2004, 17 percent of adolescents aged 12-19 were overweight, compared to just under 6 percent in 1980. Overweight adolescents have a 70 percent chance of becoming overweight adults, leaving them more vulnerable to a range of chronic diseases (MacKay & Duran, 2007). Paralleling this trend, youth are spending increasing amounts of their social leisure time online. As of 2007, 93 percent of American teens (between the ages of 12-17) reported regularly using the Internet, 64 percent of whom reported actively engaging in social and collaborative activities online. Videogames are similarly universal: As of 2008, 97 percent of American teens reported playing videogames, and 76 percent of them play games with others (Lenhart, 2007).

In this report, we describe the results of a three-semester, nationwide development of the American Horsepower Challenge (AHPC), a game for K-12 settings that addresses trends in youth physical activities and computer-based social play. AHPC is a pedometer-based video game that leverages youth online activity to encourage offline physical activity. Developed by Humana Games for Health and sponsored by The Humana Foundation, the philanthropic arm of Humana Inc., the AHPC is a game that turns everyday walking activity into a team sport.

In the following sections, we first describe the game and the schools in which children and teachers used the AHPC. We then report on self-reports provided by the children and their parents and existing opportunities for physical activity in K-12 settings. We describe how the game was implemented within school settings, and discuss the technology itself, including a heuristic usability analysis of the website and pedometer as well as a discussion of AHPC as a game. We conclude with a discussion section that includes design implications and lessons learned.

Brief Description of the American Horsepower Challenge Game

The American Horsepower Challenge addresses two trends: a decrease in youth physical activity levels and an increase in online and computer-based social play. Through a combination of wireless pedometers and a Web-based game, the AHPC tracks students' steps and turns them into points in an online school vs. school 'horserace.' Our research team has been following the participants in this

competition over two school years by collecting step data, surveying stakeholders in the game, conducting focus groups and individual interviews with students, and conducting interviews with some parents and teachers. We have investigated whether this game changes the participants' attitudes and everyday physical activity levels.

The AHPC attempts to leverage youth online activity as a way to encourage everyday physical activity. Instead of encouraging physical activity on the individual level, the AHPC introduces competition among different schools and collaboration between teammates in the same school, providing other initiatives for the children to participate in physical activities.

The AHPC takes real-world fitness data and feeds it into a virtual environment: a road race in which schools (each represented by a cartoon school bus) compete for grants from The Humana Foundation that support onsite wellness activities or services. The participating students are represented by a horse avatar that sits inside their school's bus (see Figure 1). The relative position of the school buses on the racetrack correlates with the aggregate step-counts of students in each school.

To input step-count data, each student wears a foot-mounted pedometer that wirelessly synchronizes with a base station set up in a high-traffic area in their school. Students' step counts are uploaded to the AHPC servers each time they pass within range of the base station. Students can log onto the game website to check their steps as well as their schools' aggregate number of steps (see Figure 2), see their school's standing against other schools, and purchase outfits or 'skins' for their horse avatars as a function of the number of steps the student has taken. Students can also update their 'status' and view other students' updates in a Twitter-like activity stream.

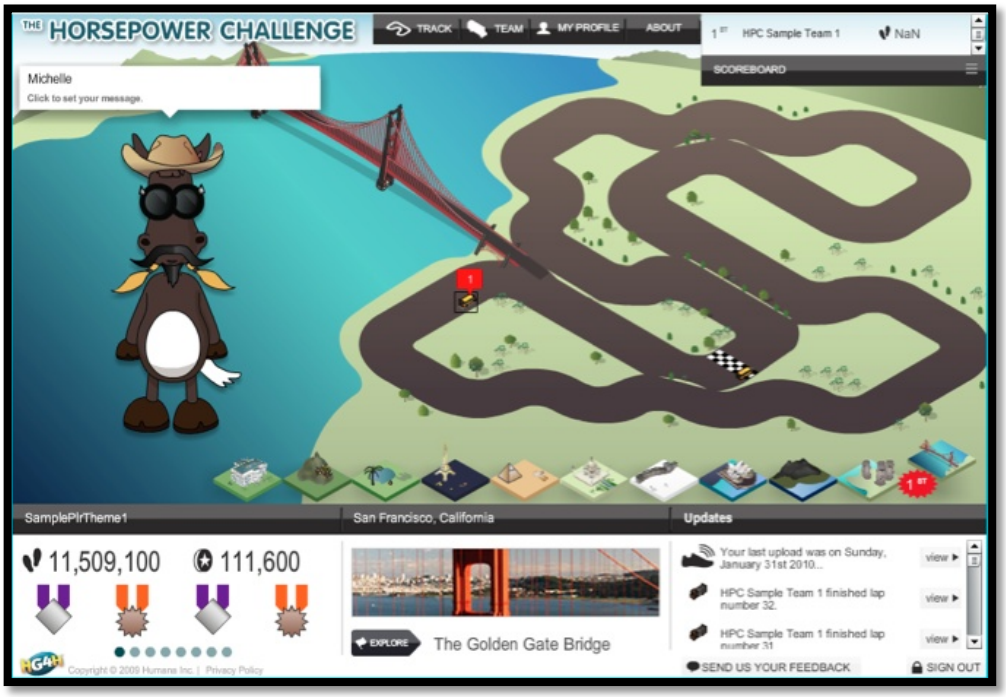

Figure 1. Game interface showing an individual avatar and the racetrack.

Figure 2. Game interface showing a schools aggregate number of steps over the past seven days.

The American Horsepower Challenge 2009-2010 Competition

The American Horsepower Challenge 2009-2010 competition consisted of three four-week long competitions, which we will refer to as 'heats'. The heats occurred during Spring 2009, Fall 2009, and Spring 2010. Participants with the greatest numbers of steps were awarded grants by the Humana Foundation to support physical activity initiatives within the school. The program began with sixty-one schools in fourteen states. The Humana Foundation recruited the schools based on participation in the National School Lunch Program, a federally assisted meal program. The average percentage of students who receive free or reduced lunch was 73.5%. The average student population of the schools was 545.5, and the average student-teacher ratio was 14.7, which is lower than the average ratio of all US public schools (15.7). There was a roughly equal number of girls and boys in the schools (male-female ratio = 1.09), and the percentage of each ethnicity was: white 39.4%, Black 30.1%, Hispanic 23.8%, American Indian/Alaskan 4.4%, and Asian 1.6%.

A total of 1,465 students participated in the Challenge; students from thirty-seven of the sixty-one schools participated in all three heats of the game. Among the 37 schools that remained in the 2nd and 3rd heats, 9 were city schools, 12 were suburban schools, 7 were in towns, and 9 were rural schools[1].

[1] Data collected from ed.gov.

Methods

Throughout the three heats (spring 2009, fall 2009, and spring 2010), we collected data using a mixed-methods approach. First, we received data collected by the pedometers worn by students, as well as information about student logins to the website. Second, we conducted site visits in which we interviewed students and teachers. Third, we distributed a series of surveys to student participants, their parents, and teachers. Figure 1 shows the timeline of data collection. We describe our data collection techniques in more detail in the sections that follow.

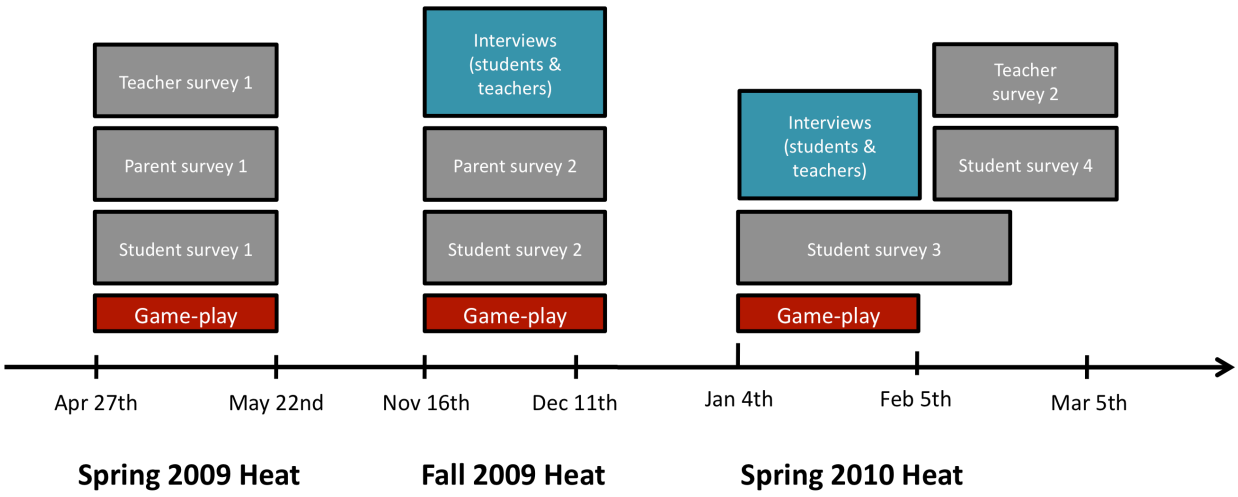

Figure 1. Timeline for both quantitative and qualitative data collection occasions.

Surveys

First, we used surveys to collect information from the students, their parents, and the teachers involved in the Challenge. We collected survey responses from the students at the beginning of each heat, as well as at the conclusion of the final heat in Spring 2010. Parents received surveys once during the first heat and once during the second heat. Teachers received surveys at the beginning (in the first heat) and the end (third heat) of the Challenge (see Table 1).

Table 1.

Survey occasions for students, parents, and teachers.

Survey type	Date	Heat
Students		
Student survey 1	April 2009	1
Student survey 2	November 2009	2
Student survey 3	January 2010	3
Student survey 4 (about the AHPC)	February	3
Parents		
Parent survey 1	April 2009	1
Parent survey 2	November 2009	2
Teachers		
Teacher survey 1	April 2009	1
Teacher survey 2	February 2010	3

STUDENT SURVEYS

Via the student surveys, we collected self-reports about participation in physical activities, feelings and attitudes towards being physically active, and the support of their social environment (school, home, friends) in being physically active.

Throughout the three heats, 654 student surveys were answered, representing 577 student participants in 39 different schools. In the spring 2009 heat, 314 student surveys were returned, in fall 2009, 210 surveys were returned, and in Spring 2010, 130 surveys were returned. Note that although general participation in the program declined, the return rate of surveys did not decline: Spring 2009 return rate was 23.56%, fall 2009 return rate was 34.20%, and Spring 2010 return rate was 26.69%.

After analyzing the data from the first survey, we redesigned sections of the student survey. The redesign decisions were made with three goals in mind: 1) to get the optimal information from the students on areas we believed to be most relevant to the AHPC, 2) to maintain consistency with the first survey so that results could be compared among the heats, and 3) to keep the survey at a manageable length.

The changes included asking about physical activities the students do on two different levels: On a macro level to get an idea of their self-reported general physical activity level, and on a micro level to understand which particular physical activities they do and how often.

We also asked more specifically about what kind of support they received from their social environment (for example, whether their family joined them for physical activities, encouraged them, and helped them plan activities around being physically active). Additionally, we added questions about their self-image, both in general and specifically in relation to playing sports. Doing this we wanted to measure attitudes and enjoyment of physical activities in a more varied manner as the measures we used in the first survey seemed to show a ceiling effect (that is, students reported overwhelmingly positive attitudes toward physical activity). We hoped that the convergence of difference questions would provide us with a more coherent story. Finally, we redesigned answer options and questions based on feedback from the first survey responses.

Student end-of-Challenge survey

At the end of the final heat, we asked the students to complete a survey focused on the experience of participating in the program. The development of this survey was guided by our experiences at the site visits. We asked for direct feedback from the students about reasons for participating in the Challenge, social aspects of participating, their view of their own performance in the AHPC, attitudes they had towards the Challenge, and the personal availability of computers and Internet connectivity both in and outside of the school setting.

A total of 186 students from 23 schools returned this final survey.

PARENT SURVEYS

The parent survey gathered information about the parent's view of his or her child's physical activities, the general activity level of the parents (Sallis, Prochaska , & Taylor, 2000), physical activities the students and their parents do together, and characteristics of the neighborhood and community where they live.

After analyzing completed parent surveys from the first heat, we redesigned the parent survey for many of the same reasons as the student survey. With the parent survey redesign, we focused on trying to maintain consistency with the original survey as much as possible, while at the same time trying to

optimize information and respond to feedback and comments the parents had about the survey the first time around.

We asked for detailed information about the physical activities students and their parents did (both on a macro and micro level), the type of support families provided for being active (e.g. joining them for physical activities, paying for lessons, or providing transportation). In addition, we wanted to get a better sense of what sorts of physical activities were possible in the neighborhoods where the participating child lived.

We received 279 completed parent surveys in the Spring 2009, representing parents of students in 20 different schools. Of these, we could link 90% of parents to a student participant. In the fall 2009, 202 surveys were returned, representing parents of students from 13 different schools. We could link 31% of the parent surveys returned in the fall to student participants. The reason for the lower percentage was that parents were asked to provide their child's name, but the students were not required to fill out their name on their survey (only their AHPC login name). It therefore became difficult to link the student and parent surveys.

TEACHER SURVEYS

The teacher survey collected information about the school environment including the opportunities the school environment provides students for being physically active (in terms of recess, physical education classes, sports, and other extracurricular activities). In the second survey, we asked questions about how the teachers integrated the AHPC into their schedules and organized participation in the game. This latter category was added in the second teacher survey because of feedback we had received during site visits indicating the wide variety of ways in which the teachers organized participation in the AHPC.

In the second survey, we also added more detailed questions about the opportunities schools provide students for being physically active based on information from the first survey and the site visits.

In the Spring 2009, 21 completed teacher surveys were returned, representing 17 different schools participating in the AHPC. In the spring 2010, 19 teacher surveys were returned, representing 19 schools.

Site Visits

Our research team visited 15 schools participating in the AHPC, conducting interviews and focus groups with over 200 students and teachers.

Starting in November 2009, we began contacting participating schools, making regular phone calls and sending emails to teachers and administrators in over 45 participating schools throughout the country. We had the opportunity to visit fifteen schools in total during the time between December 2009 and February 2010 (see Table 2). The profile of the 15 schools we visited is representative of the overall group; they are all Title I regular schools, the average percentage of students who receive free or reduced lunch was 71.8%, the average student population was 460 (slightly smaller than the average student population in the group), and the average student-teacher ratio was 14.2. There was an equal number of girls and boys (male-female ratio = 1.03), and the percentage of each ethnicity was: white 42.6%, Black 25.2%, Hispanic 25.8%, American Alaskan/Alaskan 4.3%, and Asian 2.1%. Among the 15 schools we visited, four were city schools, five were suburban schools, three were in towns, and three were rural.

At each school, we conducted a focus group with students, a teacher interview, and individual student interviews as time permitted. At School 10, which enrolled 80 students instead of the customary 20, we conducted four focus groups. Each school visit lasted at least two hours, approximately one hour for the focus group, 15 minutes for the student interviews, and 45 minutes for the teacher interview. We also received tours of facilities and shadowed the teachers during their classes if invited.

For the earlier site visits, two researchers went to each site. This approach allowed us to calibrate the interview protocols and to ensure a consistent approach across personnel. For the later site visits, we went to sites individually. Each focus group and interview was recorded for later analysis using audio and video recording tools; we also took photos at each site if permitted. After each site visit, researchers wrote ethnographic field notes that included observations of interest about the school.

Table 2.

The schools we visited and the data we collected at each site.

School name / location	Visit Date	Focus group	Individual Interview	Teacher Interview
School 25	12-09-2009	Yes	Yes (4)	Yes
School 66	12-09-2009	Yes	Yes (8)	Yes
School 14	12-10-2009	Yes	Yes (4)	Yes (2)
School 6	12-10-2009	Yes	Yes (6)	Yes (2)
School 38	12-11-2009	Yes	Yes (8)	Yes
School 50	12-15-2009	Yes	Yes (8)	Yes
School 9	12-15-2009	Yes	Yes (2)	Yes
School 7	02-02-2010	Yes	No	Yes
School 10	02-03-2010	Yes (4)	No	Yes
School 51	02-10-2010	Yes	Yes (2)	Yes
School 1	02-10-2010	Yes	Yes (4)	Yes
School 4	02-10-2010	Yes	Yes (2)	No
School 28	02-10-2010	Yes	Yes (2)	Yes
School 46	02-12-2010	Yes	Yes (4)	Yes (2)
School 60	02-17-2010	Yes	Yes (2)	Yes

To guide us in our site visits, we created a set of semi-structured focus group and interview protocols. These documents framed our discussions with students and teachers, helping us standardize the qualitative data collection process across four interviewers and multiple research sites. While the teacher interview protocol was designed like a normal interview protocol with a list of open-ended questions, the student *focus group* protocol featured interactive exercises that functioned as icebreakers and helped break up the flow of the sessions. The student *interview* protocol was designed more like a traditional usability study protocol in which the facilitator asked the student to perform tasks on the AHPC website and questioned the student on various features of the interface, however it also provided opportunities to follow up individually with students who may have been reluctant to speak in front of their peers during the focus group. In the following sections, we describe the details of the focus group and interview protocols.

STUDENT FOCUS GROUP

The focus group protocol was broken into an icebreaker activity and four main sections, with a fifth added for the spring site visits. In the icebreaker exercise, the facilitator asked students to select from a predefined list of adjectives to describe the AHPC. In the third section, this was used to elicit students' perceptions of the game, giving each student a chance to speak and creating a general discussion about the project.

The first section covered ways students collected steps in the game, including team and individual activities. If students tried additional activities to get steps, they were encouraged to share their stories during this section of the focus group. As we conducted the focus groups, we also used this section to ask about cheating because students often brought up non-standard ways to get steps in this section.

The second section asked the children about individual versus group experiences with the Challenge. We asked questions about situations in which students collected steps together, and their opinions on group vs. individual activities for getting steps. We tried to distinguish between getting steps together and 'playing the game' together to get a sense of whether students were using the website component socially and to what extent they viewed everyday step-counting as part of "the game." Again, this section evolved during our data collection; we soon adapted to asking explicitly whether the students felt like they participated in the AHPC as individuals or as a team.

The third section comprised a discussion of the icebreaker exercise as well as an attempt to elicit students' perceptions of suitability for the game. In the fourth section, we assessed individual attitudes. The facilitator asked students to close their eyes and raise their hands when they agreed with various statements about long-term behavior change. A discussion then followed about the students' perceptions of long-term behavior change.

Finally, during the spring 2010 site visits, facilitators asked about students' step-counts and perceptions of activity level and motivation during the winter break.

STUDENT INTERVIEW

In the one-on-one student interviews, we collected data about how students used and interacted with the website; we also used this individual session as an opportunity to follow-up on things the student said during the focus group, as well as give the chance for quieter participants to feel more comfortable

providing their opinions without the judgment of their peers. We conducted the individual interviews at a computer if possible; for visits in which we did not have access to a computer or the AHPC website, we showed the children screenshots of various parts of the website. Whether computer- or paper-based, each student led the interviewer through various sections of the website. The interviewer also asked the students about specific features of interest, including the horses, the track, and the “bling” for the avatars. The protocol specified various features of interest (the horses, the track, and the "bling") and the interviewer asked the student specific questions about each.

TEACHER INTERVIEW

In the teacher interviews, we asked about the teachers’ roles and responsibilities. We also asked about the culture of the school broadly as well as with respect to physical fitness specifically. We were particularly interested in the students’ access to physical fitness activities during the school-day, any initiatives the teacher had started in order to facilitate increased step-counts, and the role the teacher played in managing the students, pedometers, and base stations (RAPs) throughout the Challenge.

QUALITATIVE DATA ANALYSIS

The primary data sources used for our qualitative analysis were focus group transcriptions, interview transcriptions, and field notes. Due to the large size of the corpus (15 sites with over 30 separate transcripts), it was impractical for every researcher to read and code every transcript, and thus essential that we develop strategies to effectively analyze the qualitative data. This led to two methodological choices. First, rather than coding by hand, we used Atlas.ti, a qualitative data analysis application. This allowed us to compare inter-rater differences, perform concurrence analysis, and aggregate codes, memos and notes from different reviewers and primary sources. Second, we developed a two-phase strategy to our coding. In the first phase, all researchers read and coded all documents. Once we had stabilized our coding schema, we relaxed these requirements and only two researchers were assigned to each transcript.

Our analysis followed an iterative, inductive approach, guided by the themes identified in our survey design. That is, within the boundaries of broad categories like attitudes, motivation and social support, we sought to identify emergent themes through qualitative coding, similar to ethnographic analysis approaches such as Grounded Theory. As described above, all researchers read each of the transcripts we coded initially, and collaborated until we generated a shared interpretation. Although we relaxed

this requirement as our analysis progressed, it gave us added rigor, similar to the use of inter-rater reliability in a more controlled study.

In our early meetings, we focused on finding an analytical approach. One of the common themes across our site visits was the surprising extent and variety of teacher involvement. Another was the variety of school environments we saw and an intuition that things like school size and regular access to recess and physical education classes would affect the AHPC's effectiveness.

With this in mind, we coded an initial batch of transcripts from four schools. Three researchers participated in this phase, and each coded every transcript. In this early round, we practiced "open coding," a phase in ethnographic analysis in which researchers add codes, memos and notes "naturally" without imposing a strict set of codes or hierarchy. Many codes in these early rounds were "in vivo" codes, taken from actual transcripts. For example, in this round we coded 'cousin,' 'sister,' 'brother,' 'mother,' 'father' etc. separately, without concern for duplication or fragmentation, whereas in later rounds we simplified these into 'cousin,' 'sibling,' and 'parent' respectively.

At the end of the first round of coding, we produced over 900 codes, including 600 unique codes (only used once). Through regular meetings, we condensed these into a common set of just over 100 codes. We grouped these by stakeholder where possible (e.g. 'students'), or by concept ('motivation'). Using Atlas.ti's concurrence analysis to support and verify our own sense of the data, we constructed our stakeholder network and identified various findings, such as those reported in the "student physical activities and motivation" and "game website and technology" sections in this document.

Methodological Challenges

LONGITUDINAL ANALYSIS

It had been our goal from the start to collect longitudinal survey data on the students participating in the AHPC to understand how level of physical activities, attitudes, and feelings towards being physically active might change over the course of the Challenge. This ended up being more difficult than originally thought for reasons largely out of our control.

First, on each survey occasion only a portion of the students participating in the AHPC returned surveys and not necessarily the same students on each occasion. That is, a student might have participated in the AHPC in all three heats but only returned a completed survey once.

Second, students participating in the AHPC dropped out and new ones were added between heats. The replacement of students was found to be especially problematic between the first and second heat. During this period, many new students were added to the Challenge in the fall 2009 and the ones who had participated in the first heat dropped out. This was in large part due to change between grades and the practicalities of implementing the AHPC at the schools. For example, teachers involved in the Challenge sometimes preferred to have students in their class participating and as they had new students in the fall 2009 they changed the participants in the Challenge. Even for schools in which the same children were enrolled in the second heat, there were instances in which participants moved away and were no longer enrolled in the school.

Third, changes in the AHPC online game interface made between the first and the second heat allowed the students to choose their own login names. It seems some students participating in the first heat chose a new login name for the second heat, and as few student participants provided us with the actual names in the surveys completed in the second heat (providing login names was required) we had difficulty keeping track of who was a new addition to the game and who was not. Unfortunately, this issue became known only after the data had been collected.

As a result, we had only 12 students who we could positively identify as having answered the student survey in all three heats. This number is too low to provide a valid or meaningful longitudinal analysis of changes over time. Instead, we did two longitudinal analyses, one spanning the time from the first heat to the second heat, and another from the second heat to the third (see more on the longitudinal analyses in the student physical activities and motivation chapter). Therefore, even if we did not manage to analyze changes in the course of the three heats as a whole, we did manage to get longitudinal results of the AHPC.

STUDENT PARTICIPANT SELECTION

A related concern was the diversity of selection procedures used in schools to select the student participants. As mentioned, some teachers preferred to have only students in their class participate and even handpicked participants whereas others drew students randomly from the whole grade. We did not realize the extent of the variety of methods used until after starting the site visits and comparing notes from teacher interviews. To try to assess what methods for selection were used we asked the teachers in the second teacher survey about their recruitment methods. Fifteen teachers answered this question. Five said they chose more responsible students four chose students because they showed

interest, four randomly drew students from the grade roster, two drew students from those whose parents returned the consent form, two drew students who were in a particular class period, and two picked students who were believed to do well in the program. There were two schools where the number of participants of the AHPC was the exact number of students in the grade.

The wide variety of student recruitment practices at the schools poses a problem in that the student samples differ accordingly. If only the most responsible students were chosen the odds are participation over time is inflated as these students tend to take the responsibility handed them more seriously than maybe the average student at the school who would have dropped out earlier. The same goes if only the most enthusiastic students were chosen. Also, if students were chosen based on whether they were expected to do well in the AHPC program (for example because of their activity level before the AHPC) there might be reason to believe that the AHPC would not impact their activity level much or change it over time.

SITE VISITS

While overall our qualitative data collection and analysis procedures worked effectively, we did encounter a few issues along the way. Some of our questions, such as the focus group segment on people who would and would not like playing the game, resulted in superficial responses from the students and were ultimately not particularly helpful; this problem is inevitable given the structure of the Challenge. If repeating this type of research, it would be extremely helpful to have the *same* research team engage in a pilot study prior to the national launch of the game.

We decided to focus on breadth over depth, visiting as many schools as possible, rather than focusing in on a few schools throughout the study and visiting repeatedly across the three heats. By visiting many schools, we were able to get a holistic picture of the different environments in which the AHPC was deployed, but this emphasis necessarily limited our ability to answer some questions we would have like to examine. For example, our view into the AHPC's impact on the home was extremely limited, relying solely on student reports in the focus group setting. We also lacked long-term ethnographic observational data that could have triangulated student descriptions of behavior.

The site visits we proposed to schools were in competition with final exams, standardized tests, and other activities planned far in advance. Although we contacted each school at least three times by phone, and followed up by email, about two-thirds of the schools declined participating in a site visit.

Student Self-Reports of Physical Activities and Attitudes

This chapter includes all analyses on the information collected through surveys on the students' physical activities. It covers the general activity level of the students, the specific activities they do, their participation in organized physical activities (such as sports and physical education classes), their attitudes and feelings towards being physically active, and correlation of survey measures to number of steps logged with the pedometer in the Challenge.

The chapter is organized by type of analysis, the results from the longitudinal analyses of the survey data are presented first, then the main findings from the student survey administered in each heat and a brief comparison of findings among the heats, and finally the correlation between number of steps logged in the AHPC and self-reported activity level and attitudes towards being physically active.

Longitudinal Analysis of Surveys

In order to determine whether participating in the AHPC had any long-term effect the attempt was made to analyze survey responses for participants who participated in all three heats and answered the surveys on all three occasions. Unfortunately, only 12 AHPC participants had done so and therefore a longitudinal analysis across the three heats is not valid or informative. Instead, we decided to analyze changes from the spring 2009 heat to the fall 2009 heat, and changes from the fall 2009 heat to the spring 2010 heat separately. This allows us to include respondents that returned two out of the three surveys and increase number of students included in the analysis.

There were 37 respondents who answered surveys both in spring 2009 and fall 2009 (first phase of the longitudinal analysis), and 33 respondents answered the surveys both in fall 2009 and spring 2010 (second phase of longitudinal analysis). Note that these were the respondents we could positively identify as having answered surveys on at least two occasions.

First phase participants – Spring2009 to Fall 2009

There were 37 AHPC participants that returned surveys in both the spring 2009 and fall 2009 representing six different schools (see Table 1). The majority (33 or 89%) of them were from three of

the six schools: School 4, School 6, and School 50. About half of the participants were girls (52%). The students were between 11 (24%) and 12 (76%) years old.

Table 1.

Number of student AHPC participants that answered surveys both in the spring 2009 and fall 2009.

School	Nr of students	% of total (N = 37)	% Girls	% 12 years old in spring 2009
School 4	7	19%	71%	43%
School 6	14	38%	57%	32%
School 25	1	3%	100%	50%
School 50	12	32%	35%	43%
School 66	2	5%	50%	25%
School 70	1	3%	0%	50%

Participants could select any number of racial identity categories they believed applied to them, therefore these numbers are not provided in percentages even if the majority of participants (81%) only selected one racial category. Most participants (n = 30) identified themselves as white (three of those at least partly), six as Hispanic or Latin American (two partly), and five specified another racial identity than provided in the list (three partly). One participant identified him/herself as partly Native American and three participants identified themselves as partly black.

Second phase participants – Fall 2009 to Spring 2010

A total of 33 students participating in the AHPC returned surveys in both the fall 2009 and spring 2010 heats, representing eight different schools (see Table 2). Two-thirds (67%) of them were from two schools: School 4 and School 66. About two-thirds of the respondents were girls (63%), and the majority (79%) were 13-14 years when they took the survey in the fall 2009 (9% were younger than 13, 6% were older, and 6% did not answer).

Table 2.

Number of student AHPC participants that answered surveys both in the fall 2009 and spring 2010.

School	Nr of students	% of total (N = 33)	% Girls	% 13-14 years old in fall 2009
School 1	2	6%	--	50%
School 4	14	42%	64%	86%
School 9	2	6%	50%	50%
School 10	1	3%	--	50%
School 28	2	6%	50%	0%
School 50	3	9%	67%	100%
School 66	8	24%	63%	100%
School 70	1	3%	0%	100%

Participants could select any number of racial identity categories they believed applied to them, therefore these numbers are not provided in percentages even if the majority of participants (89%) only selected one racial category. Most participants (17) identified themselves as white (two of those at least partly), 10 as black or African American (five partly), and six specified another racial identity than provided in the list (all of these partly). One participant identified themselves as partly Asian and three participants as Hispanic or Latino/Latina.

Number of steps

When the numbers of steps logged were averaged for the respondents included in the longitudinal analyses, it turns out that the steps these students logged decreased between heats (see Figures 1 and 2). For the respondents in the first phase, the steps decrease significantly between the spring and fall 2009 heats ($t(36) = 2.11$, $p < .05$, (two-tailed). There was also a trend of decreasing steps in the second phase, but the difference between the fall 2009 and spring 2010 heats was not significant ($p > .05$).

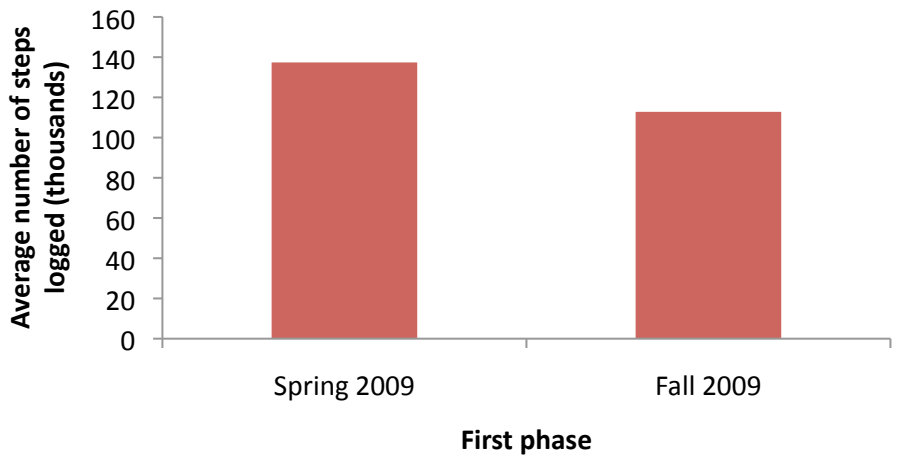

Figure 1. Average number of steps in the first phase for the respondents in longitudinal analysis.

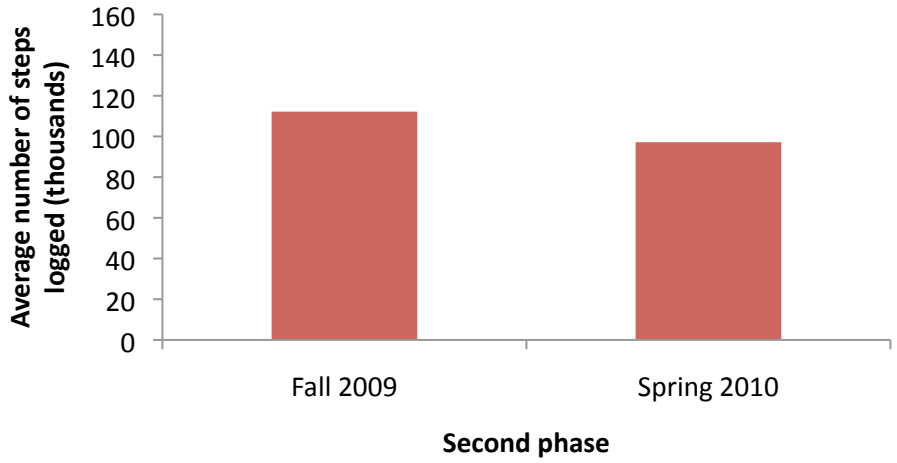

Figure 2. Average number of steps in the second phase for the respondents in longitudinal analysis.

There was a significant ($p < .05$), strong positive correlation between the number of steps logged by a student in the first heat and the steps logged by that same student in the second heat ($r = .49$). This indicates that as the students logged more steps in first heat they were also more likely to log more steps in the second heat. The same was true of the second phase ($r = .46$).

FIRST PHASE: SPRING 2009 HEAT TO FALL 2009 HEAT

The analyses below are based on 37 AHPC participants. The survey underwent changes from the first heat to the second and therefore comparisons are limited to a degree (reasons for the redesign of the survey are provided in the method section).

The first phase comparison for the group of respondents who answered both surveys will be threefold: (1) Physical activity, which covers general physical activity level, specific physical activities, and participation in organized activities, (2) feelings towards being physically active and (3) social support.

Physical activity

General physical activities and health

In both heats of the first phase, respondents were asked some general questions about being physically active. Specifically, they were asked to rate how much they agreed with the statements "I am capable of being physically active", "I'm only physically active when I'm in the mood for it", "I'm usually too busy for physical activity", "I'm usually too tired for physical activity", "I spend a lot of time outdoors", and "I eat healthy foods". The respondents were asked to indicate how much they agreed or disagreed with these statements on a five point Likert scale (ranging from "I disagree a lot" to "I agree a lot"). The answer options were coded such that a higher number represented more agreement with the statement and Figure 3 shows the comparison of the evaluation of these statements for the fall and spring 2009 surveys.

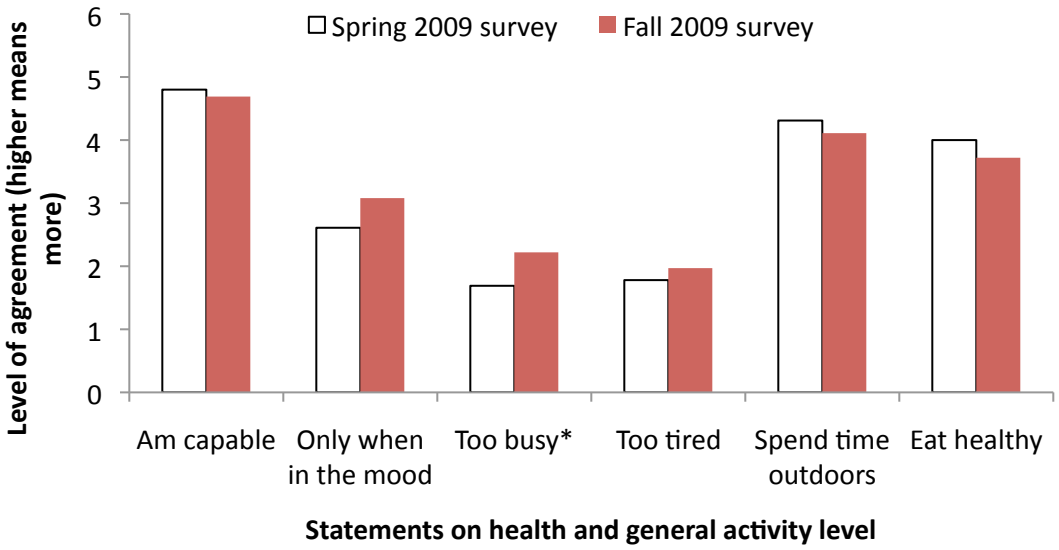

Figure 3. Average level of agreement with statements concerning general physical activities and health, a higher score indicates more agreement with the statement. The statement where a significant difference was found between the two heats is marked with a star.

A significant difference in agreement between the two heats was only found for one statement “I’m too busy for physical activity”, where the respondents tended to agree more with the statement in the fall than in the spring ($t(35) = 2.36$, $p < .05$ (two-tailed)). The question is why this difference occurs: Two possible reasons are that the schedule in the higher grade more demanding than in the lower grade, or the fall semester is generally more busy than the spring semester (due to for example other extracurricular activities).

There was a marginally significant difference in agreement to the statement “I’m only physically active when I’m in the mood for it” ($t(35) = 1.89$, $p = .068$ (two-tailed)), and again the agreement tended to be higher in the fall than in the spring.

Specific activities

In the spring 2009 survey we presented respondents with a list of activities and asked them to circle the activities they did at least once a week. This question was modified for the fall 2009 survey in two ways. First, the list of activities was made more specific (for example, instead of having “playing sports” as an activity we listed different types of sports such as basketball, baseball, and soccer) and included only activities that could be considered physically oriented (activities such as “playing board games” and “visiting a museum” were deleted). Second, instead of asking respondents to circle the activities they did at least once a week, we asked them to mark how frequently they did each activity on a five-point Likert scale (at least daily, at least weekly, at least monthly, a few times a year, and never). Because of this redesign into finer granularity on types of activities and frequency, the comparison between the survey data collected in the spring 2009 and fall 2009 is necessarily at the level of the greater granularity used in the spring 2009 survey.

There were 12 different activities we could compare (see Table 3 and Figure 4). The category "playing sports" included baseball/softball, basketball, football, soccer, running, hockey, and racquet sports (e.g., tennis or badminton) from the fall 2009 survey. The category "working out at the gym" included doing exercises (e.g., pushups, sit-ups, jumping rope, aerobics) and lifting weights listed in the fall 2009 survey. The category "active and outdoor play" refers to playing at the playground and playing outside in the spring 2009 survey and ballgames, active games, and outdoor play in the fall 2009 survey. The category "camping, fishing, and hiking" combines these three categories from the fall 2009 survey.

The comparison was done based on how many respondents said they did the activity at least weekly (because that the frequency used in the spring survey). There was significant difference between the two surveys for only three of the 12 activities. More respondents went swimming at least weekly in the spring as compared to the fall, which should not be surprising given that this is in many parts of the country a seasonal activity. More respondents said they worked out in the fall than in the spring, but this finding needs to be carefully interpreted as the question mentioned a gym specifically in the spring survey but doing exercises and lifting weights in the fall survey. It could be that respondents who did these activities but in another setting (not a gym), would not have circled this activity in the spring survey. More respondents said they walked a dog at least weekly in the fall than in the spring of 2009, and it could be that respondents saw walking the dog as a good opportunity to accumulate steps in the fall (but hadn't thought of it in the spring until doing the survey.

Table 3.

The number and percentage of respondents who report doing the listed activities by heat.

Activity	Nr of students do at least weekly in spring 2009	% of students do at least weekly in spring 2009	Nr of students do at least weekly in fall 2009	% of students do at least weekly in fall 2009
Playing sports	32	87%	29	81%
Swimming*	11	30%	3	8%
Working out*	5	14%	27	75%
Walking	32	87%	29	81%
Dancing	11	30%	9	25%
Cheerleading	2	5%	2	6%
Active/outdoor play	32	87%	28	78%
Cleaning house/indoor chores	30	81%	30	83%
Yoga	3	8%	6	17%
Building things	10	27%	12	33%
Camp/fish/hike	8	22%	8	22%
Walk the dog*	12	32%	18	50%

* The difference between heats is significant at the .05 alpha level.

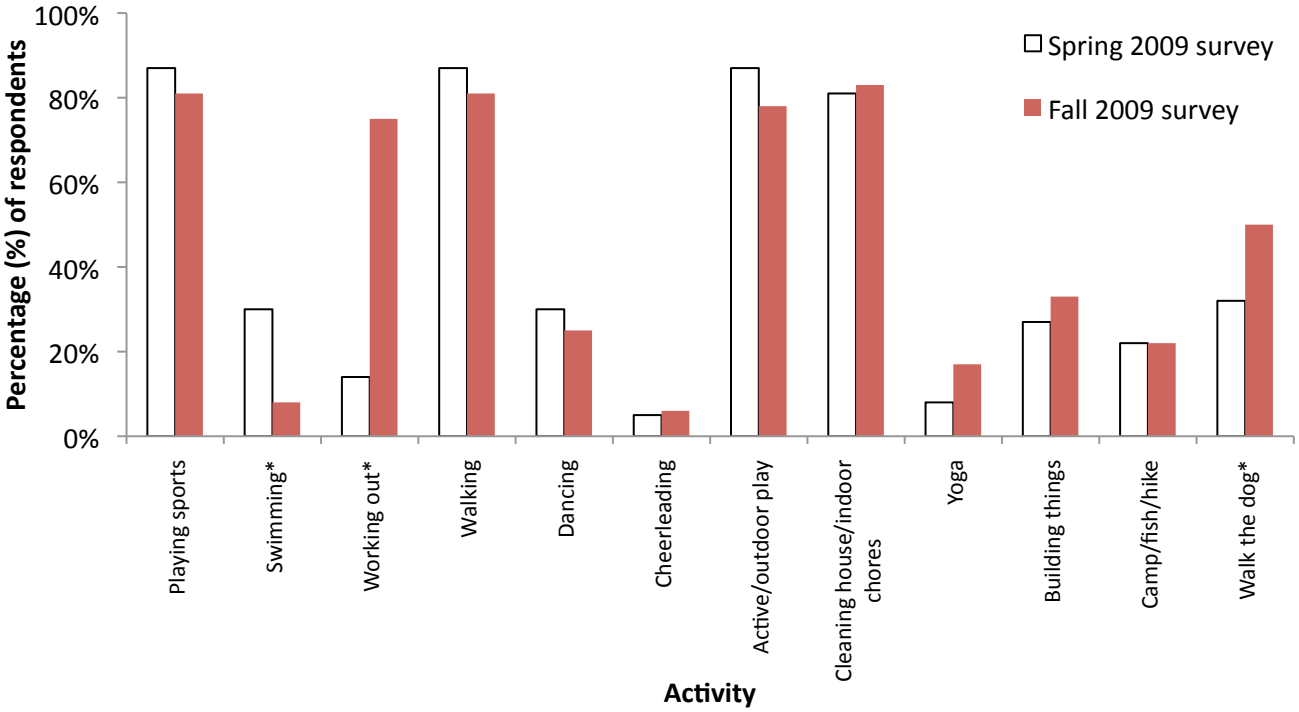

Figure 4. Percentage of respondents who engaged in the listed activities at least weekly in the spring and fall 2009. Activities where there was a significant difference found between the two heats are marked with a star.

Organized physical activities

Respondents were asked whether they had an opportunity at their school or in their neighborhood to join a sports team if they wanted to, and the majority of respondents indicated that they indeed had these opportunities (89% in the spring and 81% in the fall). This difference between the heats was marginally significant ($t(35) = -1.87$, $p = .07$ (two-tailed)).

More of the respondents practiced or played with a sports team almost every day in the spring 2009 as compared to the fall 2009, however more respondents did so a few times a week in the fall as compared to the spring (see Figure 5). The difference in frequency of practicing and playing with a sports team was not found to be significantly different for the two heats ($p > .05$).

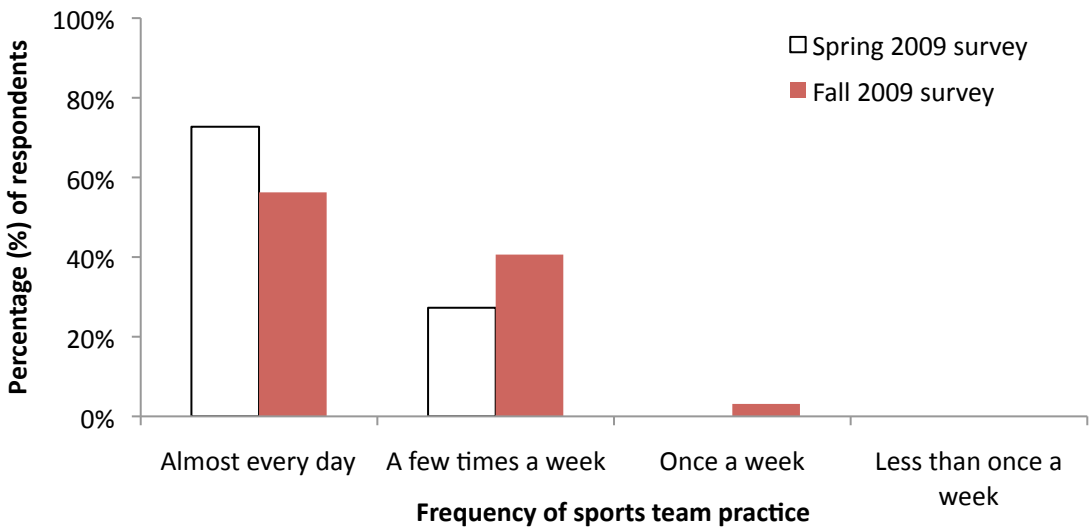

Figure 5. Frequency of practicing or playing with a sports team in the spring and fall 2009.

The respondents were asked to what degree they agreed with statements describing attitudes towards sports and competitive situations (see Figure 6). Overwhelmingly the respondents agreed with the statements "I think of myself as an athlete", "finishing a race is more important than winning", and "I am a competitive person", but tended to disagree with the statement "playing sports and exercising is embarrassing". Because of the strong agreement with the statements on finishing a race being more important and being a competitive person it seems that social desirability does play a role in the ratings as these two statements do present somewhat of an opposition. There was no difference in the level of agreement with the four statements across the two heats ($p > .05$ in all four cases).

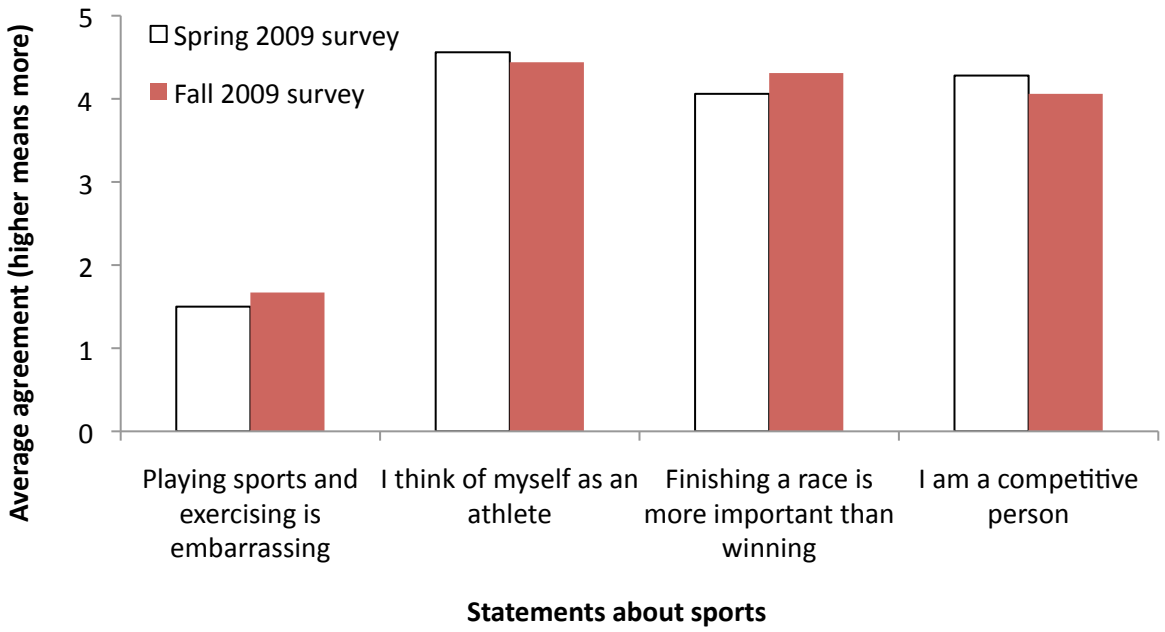

Figure 6. Average agreement with statements about sports and competitive situations in the spring and fall 2009.

When asked whether they considered physical education (PE) classes fun or boring, the majority of respondents considered PE classes fun rather than boring (84% in the spring and 78% in the fall). There was not a significant difference between the two heats in terms of how fun or boring they considered PE ($p > .05$).

Feelings towards being physically active

The respondents were asked to rate on a five-point scale how much the agreed or disagreed with different statements of how being physically active made them feel. The answer options were coded such that a higher number represented more agreement (i.e., 5 = "I agree a lot"). The scores were then averaged for the participants answering the surveys in each heat. Figure 7 depicts the average agreement with statements describing positive aspects of being physically active, whereas Figure 8 depicts average agreement with statements describing negative aspects of being physically active.

Overall, the respondents tended to agree with the positive statements and disagree with the negative ones in both heats. When the scores for the two heats were compared, the respondents agreed less with the statements "when I'm physically active, I find it satisfying", "when I'm physically active, it gives me energy", and "when I'm physically active, my body feels good" in the fall than they did in the spring.

In addition, the respondents tended to disagree less with the statement “when I’m physically active, I’d rather be doing something else” in the fall than in the spring. Taken together this indicates that the respondents were less enthusiastic about being physically active in the fall than they were in the spring of 2009.

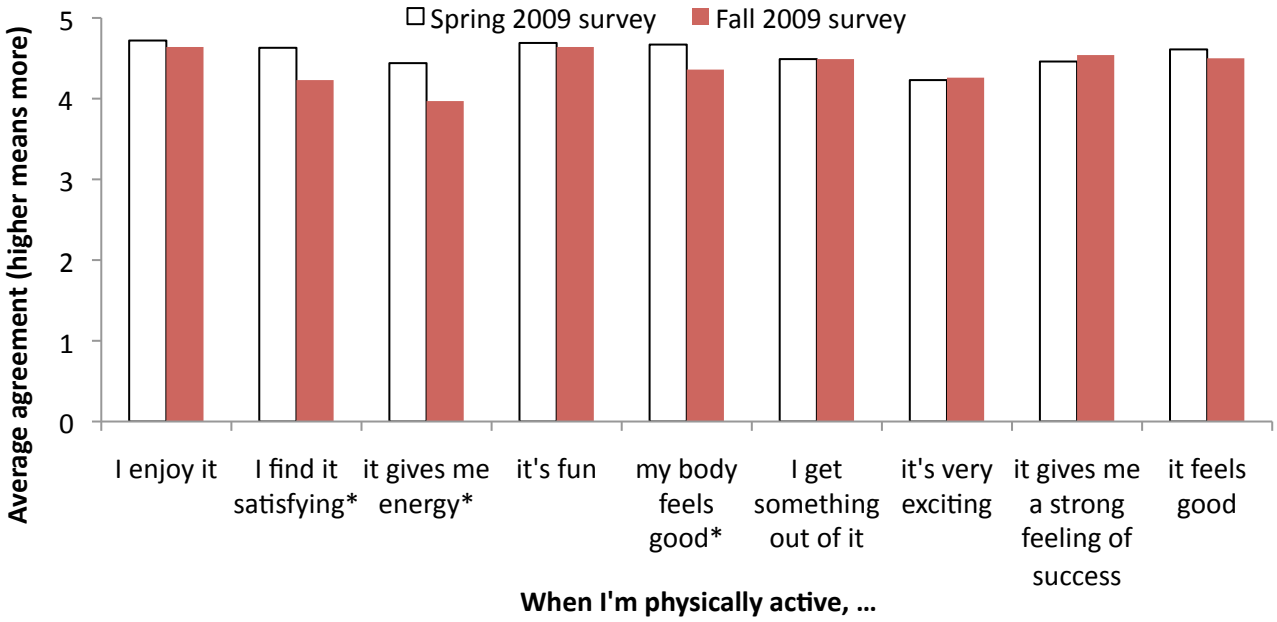

Figure 7. Average agreement with statements describing **positive** aspects of being physically active for the spring and fall 2009 survey respondents. Statements where a significant difference in agreement was found between the two heats are marked with a star.

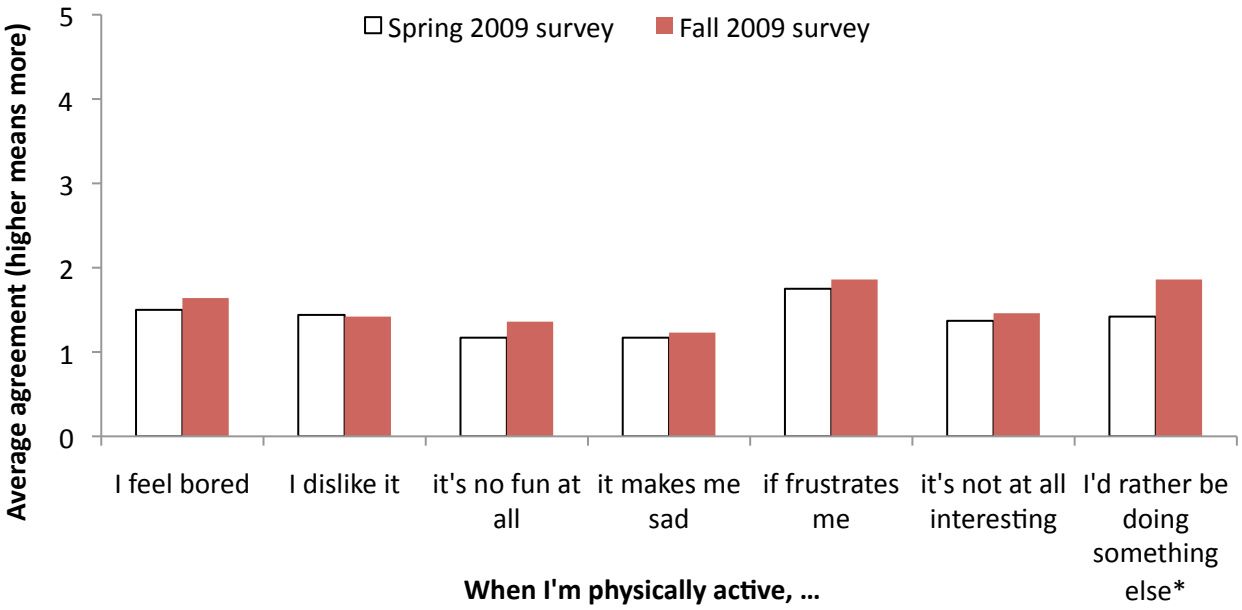

Figure 8. Average agreement with statements describing **negative** aspects of being physically active for the spring and fall 2009 survey respondents. Statements where a significant difference in agreement was found between the two heats are marked with a star.

Social context and support

Respondents were asked whether they agreed or disagreed with statements saying that their friends or families are physically active. The answers were coded such that a higher score indicated more agreement (see Figure 9). Overall, the respondents agreed that their friends are physically active (the score 4 means they agreed a little on average), but there was less agreement with the statement that their families are physically active, with the mean score being between 3 (neither agree nor disagree) and 4 (agree a little). There was no significant difference between the agreement ratings for the two heats ($p > .05$).

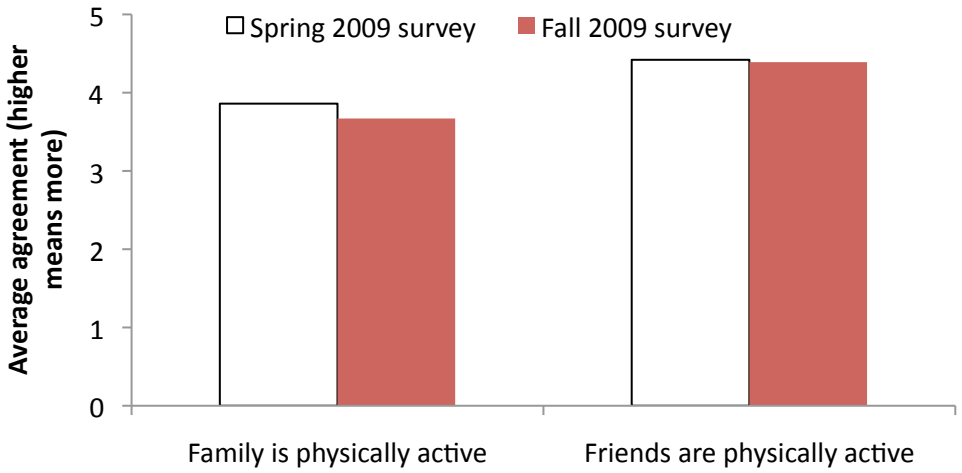

Figure 9. Average agreement with statements that family and friends are physically active for the spring and fall 2009 survey respondents.

In both the spring and fall 2009 surveys, the respondents were asked whether family or friends join them for physical activities. In the spring 2009 survey the respondents were asked, "when you are physically active, who usually joins you?" and given among others option to select "other kids in my family", "an adult family member", "my classmates", and "friends who aren't in my class". The first two answer categories were aggregated into "family" and the last two into "friends" for the analysis. This was done because in the fall 2009 survey the respondents were asked specifically whether family or friends exercised with them (that is, a distinction between kids and adults in family, and classmates and friends outside the classroom was not made). Instead, the respondents were asked to rate the frequency with which family or friends exercised with them. This frequency rating was aggregated to represent either an either or rating to allow for comparison to the spring 2009 survey. The outcome was two variables representing whether or not family or friends joined the respondents in doing physical activities.

In the spring 2009 the majority of respondent said that family and friends joined them for physical activities, but in the fall 2009 the percentage of respondents saying that family joined them for physical activities had dropped significantly (t (35) = -2.94, $p < .05$ (two-tailed)), there was however no difference in the percentage who said that their friends joined them for physical activities (see Figure 10).

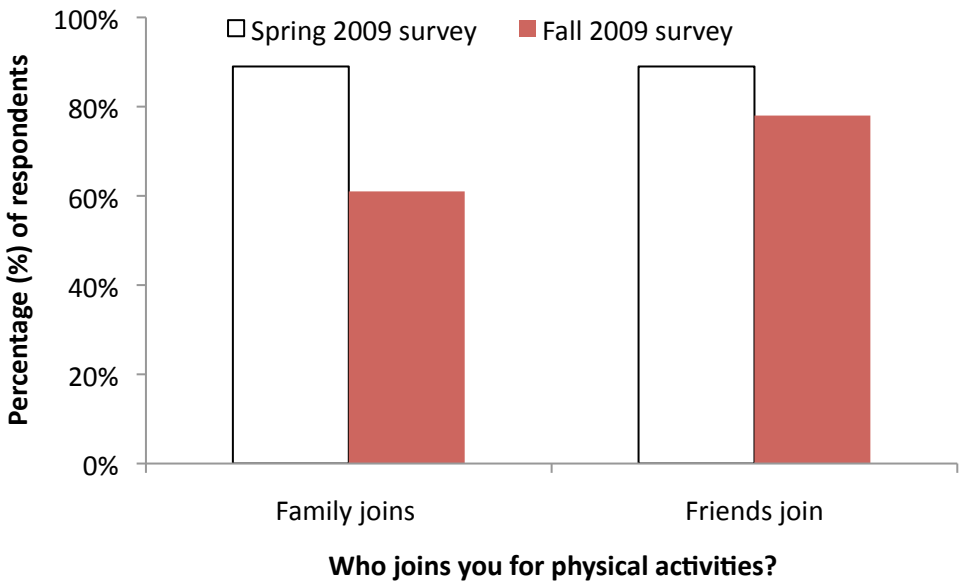

Figure 10. Percentage of respondents who say that family and friends join them for physical activities, shown separately for spring and fall 2009 surveys.

The respondents were similarly asked who encourages them to be physically active in the spring 2009 survey, and in the fall 2009 survey, they were asked how frequently their family, friends, or teacher encouraged them to be physically active. These questions were combined to allow for comparison between the two heats, such that three different variables were created – one indicating whether or not family encouraged the respondents to be physically active, another assessing the same but for friends, and the third referring to teachers.

The respondents reported getting more encouragement from family and friends in the spring heat than the fall heat and this difference was found to be significant in both cases (family: $t(35) = -3.42$, $p < .05$, (two-tailed), friends: $t(35) = -3.18$, $p < .05$ (two-tailed), see Figure 11). The pattern was different for teachers, more respondents reported getting encouragement to be physically active from their teachers in the fall than in the spring – one reason could be that in the fall, the respondents were specifically asked to think of the teacher who was involved in the AHPC, but not in the spring – this difference was not significant though.

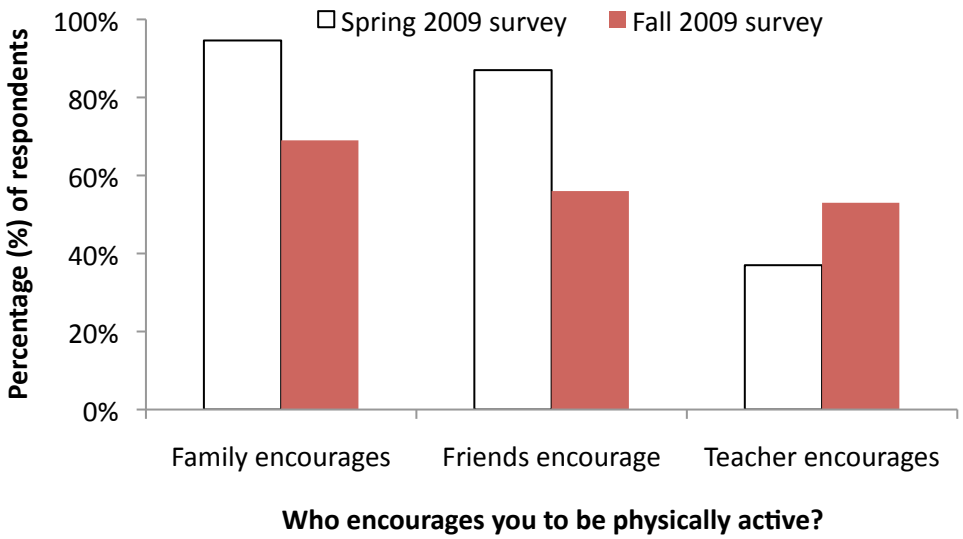

Figure 11. Percentage of respondents who say that family, friends, or teacher encourages them to be physically active, shown separately for spring and fall 2009 surveys.

SECOND PHASE: FALL 2009 HEAT TO SPRING 2010 HEAT

The analyses below are based on 33 AHPC participants.

Physical activity

General activity level and health

Respondents were asked how many times during a typical week they do strenuous, moderate, or mild exercise for at least 15 minutes. There was no difference between the answers respondents gave in the fall 2009 as compared to spring 2010 for any of the three types of exercises ($p > .05$ in all three cases; see Figures 12-14).

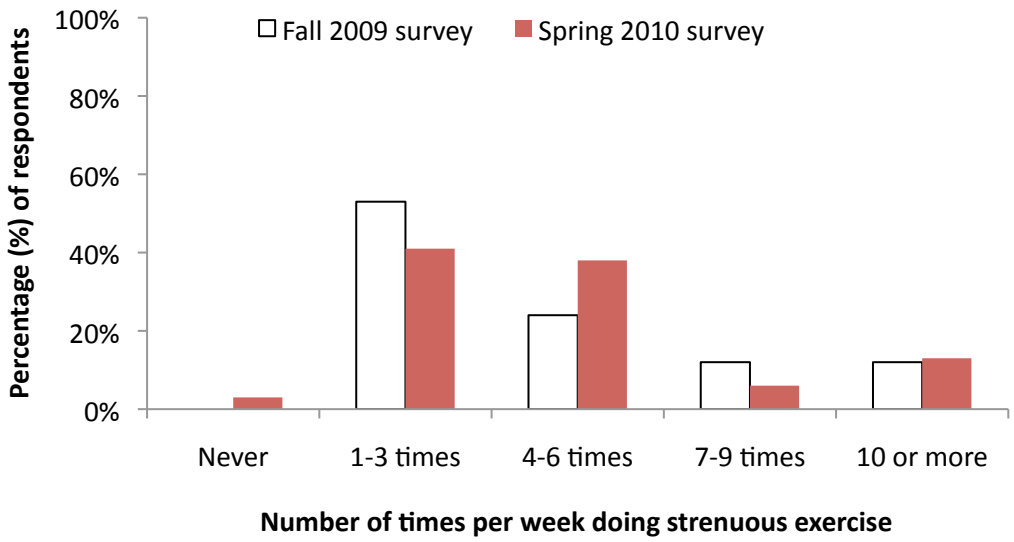

Figure 12. Percentage of students who reported doing strenuous exercise for a specified number of times per week for at least 15 minutes at a time.

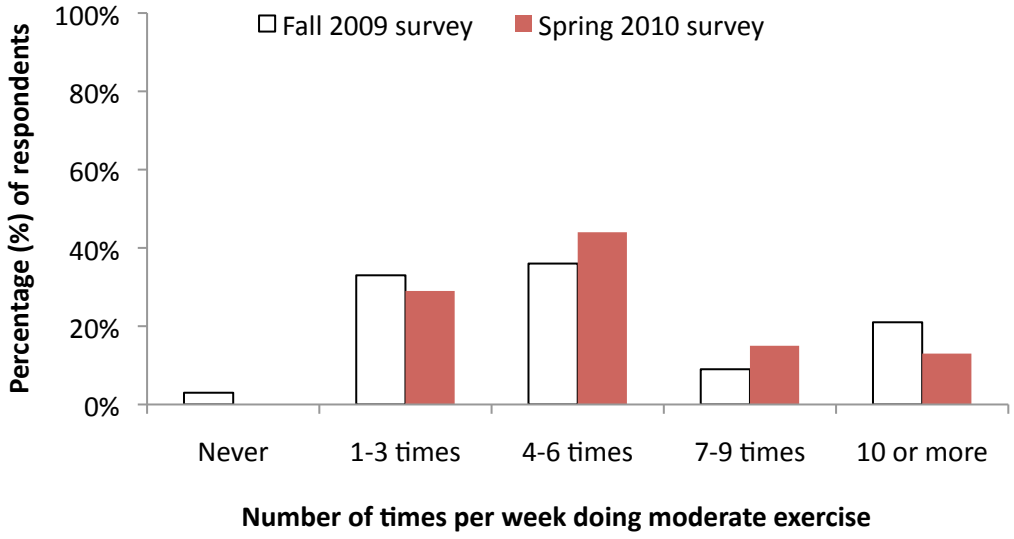

Figure 13. Percentage of students who reported doing moderate exercise for a specified number of times per week for at least 15 minutes at a time.

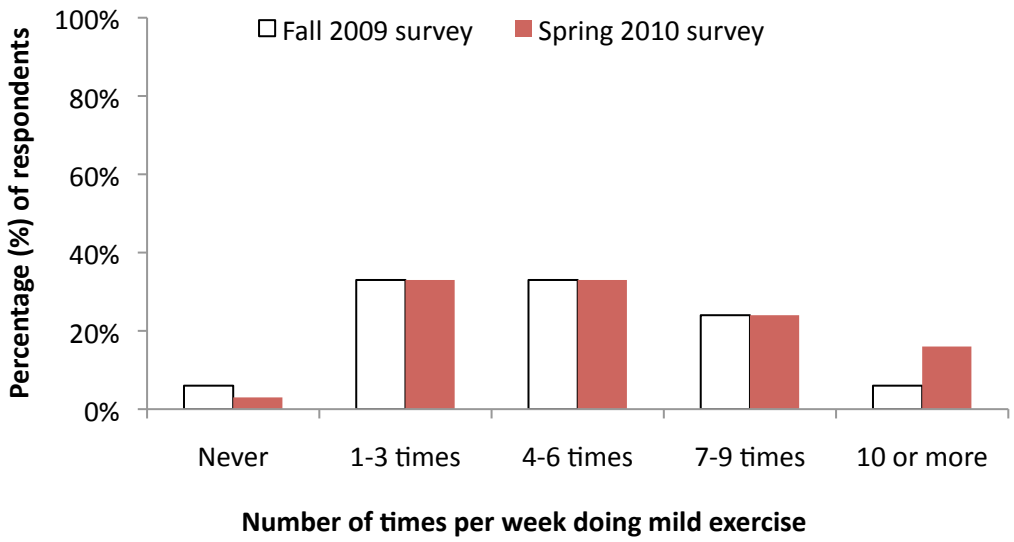

Figure 14. Percentage of students who reported doing strenuous exercise for a specified number of times per week for at least 15 minutes at a time.

When asked about their general activity level on most days, the majority of respondents rated it as medium, high, or very high both in the fall 2009 and spring 2010 (see Figure 15). There was no difference in how high the respondents rated their general activity level on the two survey occasions ($p > .05$).

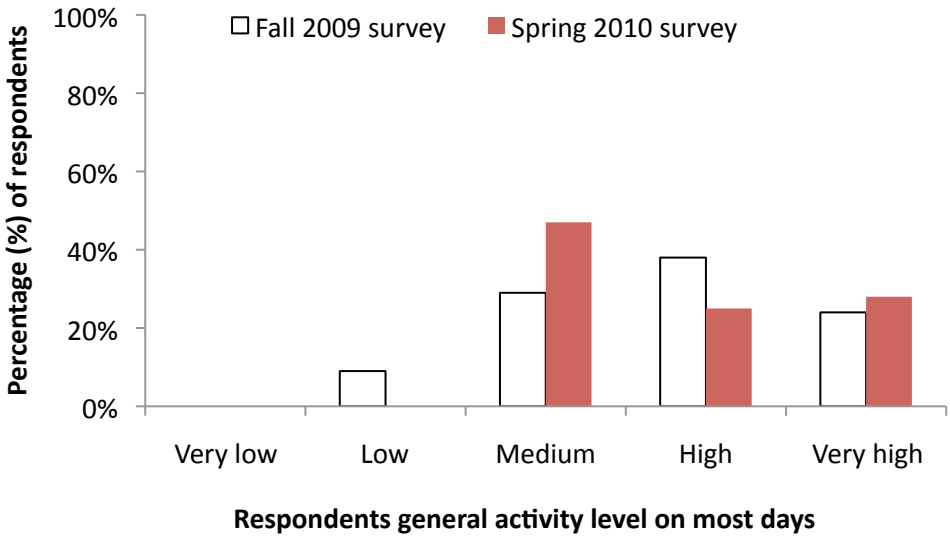

Figure 15. Percentage of respondents who describe their daily physical activity level as very low, low, medium, high, or very high in the fall 2009 and spring 2010.

About two-thirds of the respondents rated their general activity level on most days as about the same as other people their age, and this was true for both heats (see Figure 16). Very few respondents said their own general activity level was less than for other people their age. There was no difference between the two survey occasions on how the respondents rated their general activity level compared to their peers ($p > .05$).

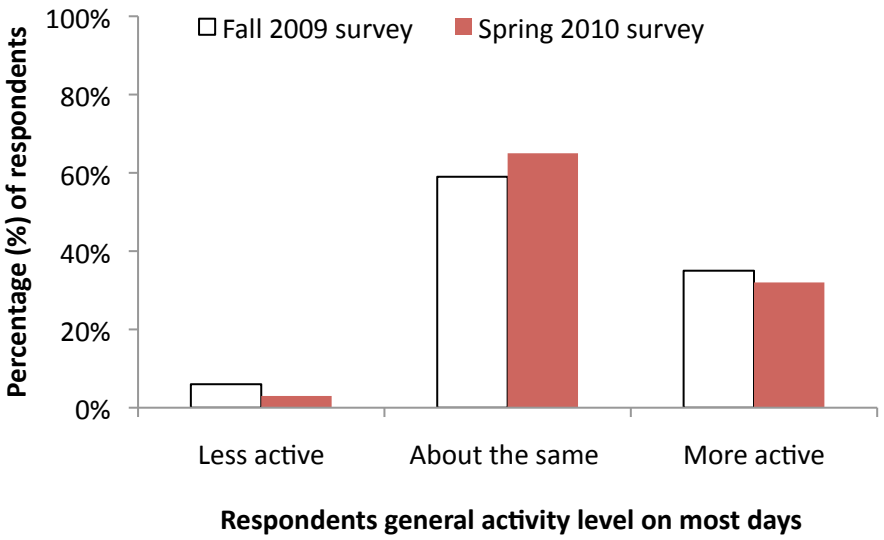

Figure 16. Percentage of respondents who describe their general activity level as less active, about the same, or more active than other people their age in the fall 2009 and spring 2010.

In both heats, respondents were asked some general questions about health and being physically active. Specifically, they were asked to rate how much they agreed with the statements "I am capable of being physically active", "I'm only physically active when I'm in the mood for it", "I'm usually too busy for physical activity", "I'm usually too tired for physical activity", "I spend a lot of time outdoors", "I eat healthy foods", and "I eat junk food". The respondents were asked to indicate how much they agreed or disagreed with these statements on a five point Likert scale (ranging from "I disagree a lot" to "I agree a lot"). The answer options were coded such that a higher number represented more agreement with the statement and Figure 17 shows the comparison of the evaluation of these statements for the fall 2009 and spring 2010 survey results.

A significant difference between the fall 2009 and spring 2010 surveys was found for agreement with the statement "I spend a lot of time outdoors" ($t(26) = 2.50$, $p < .05$, (two-tailed)). Respondents agreed more with the statement in the fall than in the spring. This result is understandable given that the spring

data were collected in January and February and presumably in most parts of the country outdoor activities are more limited that time of year as compared to November. No other difference was found between agreement ratings on the statements for the two heats.

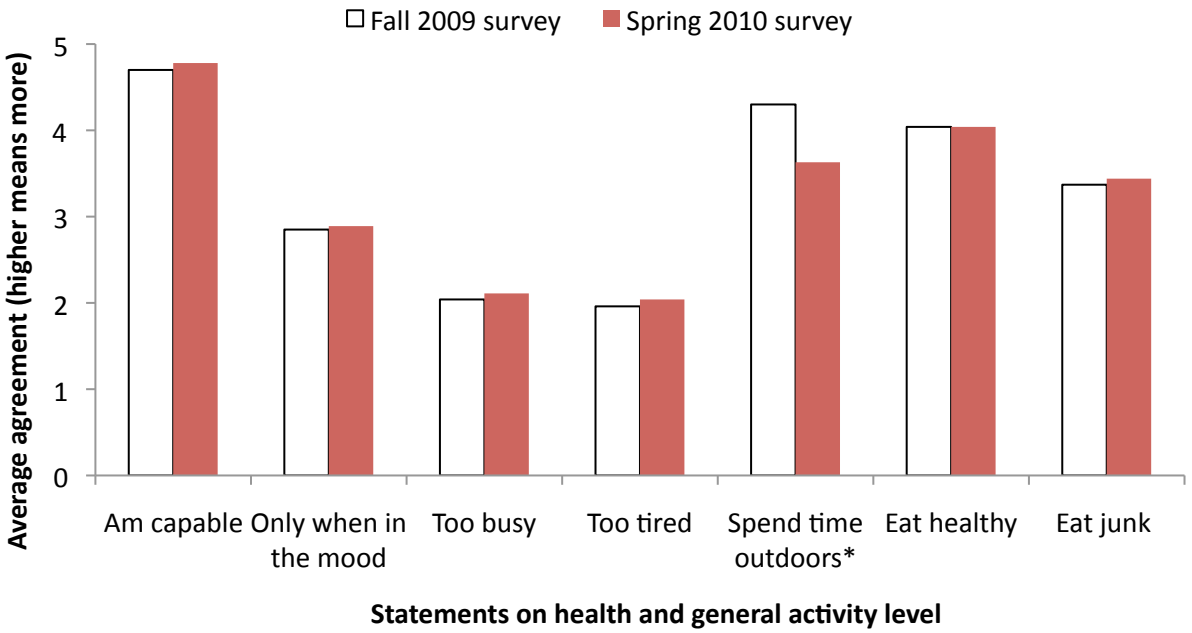

Figure 17. Average level of agreement with statements concerning general physical activities and health, a higher score indicates more agreement with the statement. The statement where a significant difference was found between the two heats is marked with a star.

Specific activities

The respondents were asked both in the fall 2009 survey and the spring 2010 survey with what frequency they did each of the listed activities. The answer options ranged from “at least daily” to “never” and were coded from 1 to 5, with a higher number representing a more frequently done activity. To compare the frequency with which each activity was done in the two heats, the scores for each activity were averaged for each heat where a higher number represents a more frequent event. The results are shown in Figures 18, 19, and 20.

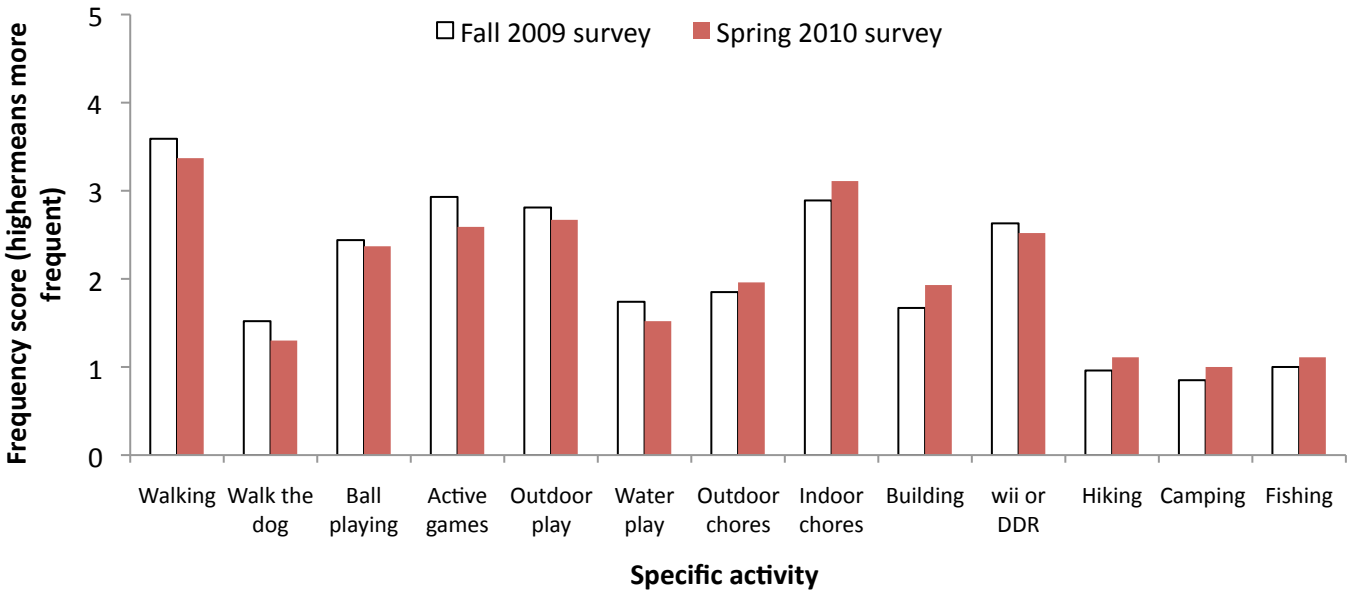

Figure 18. Frequency score for each activity, averaged for the fall 2009 and spring 2010 heats separately. A higher score indicates a higher frequency (1 = never and 5 = daily). The activities in which a significant difference was found between the two heats are marked with a star.

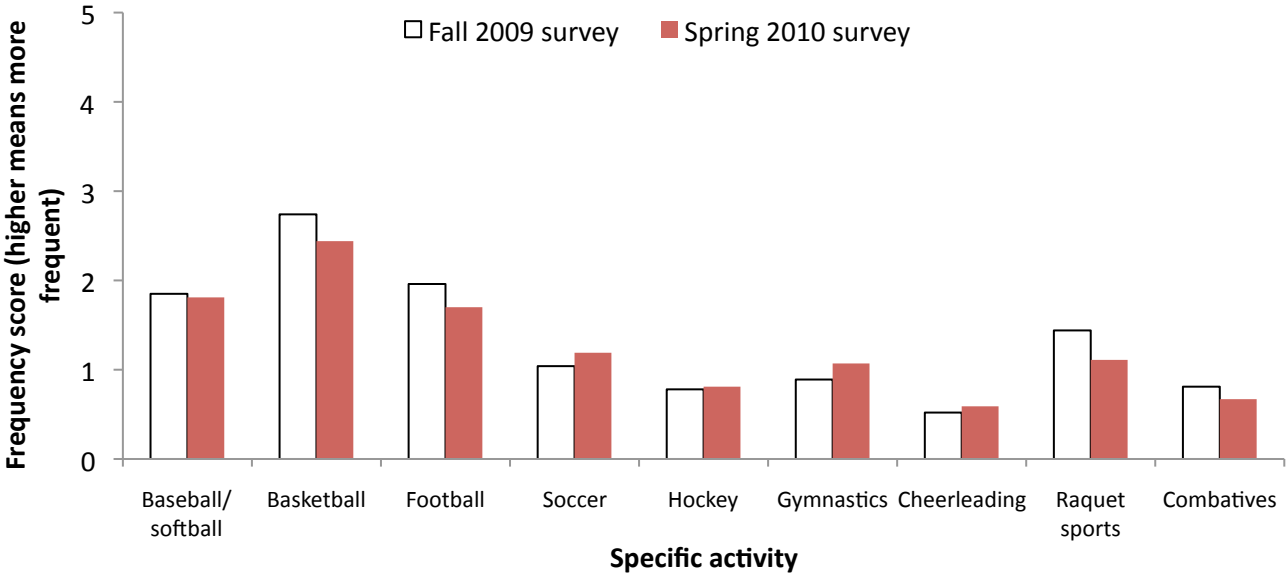

Figure 19. Frequency score for each activity, averaged for the fall 2009 and spring 2010 heats separately. A higher score indicates a higher frequency (1 = never and 5 = daily). The activities in which a significant difference was found between the two heats are marked with a star.

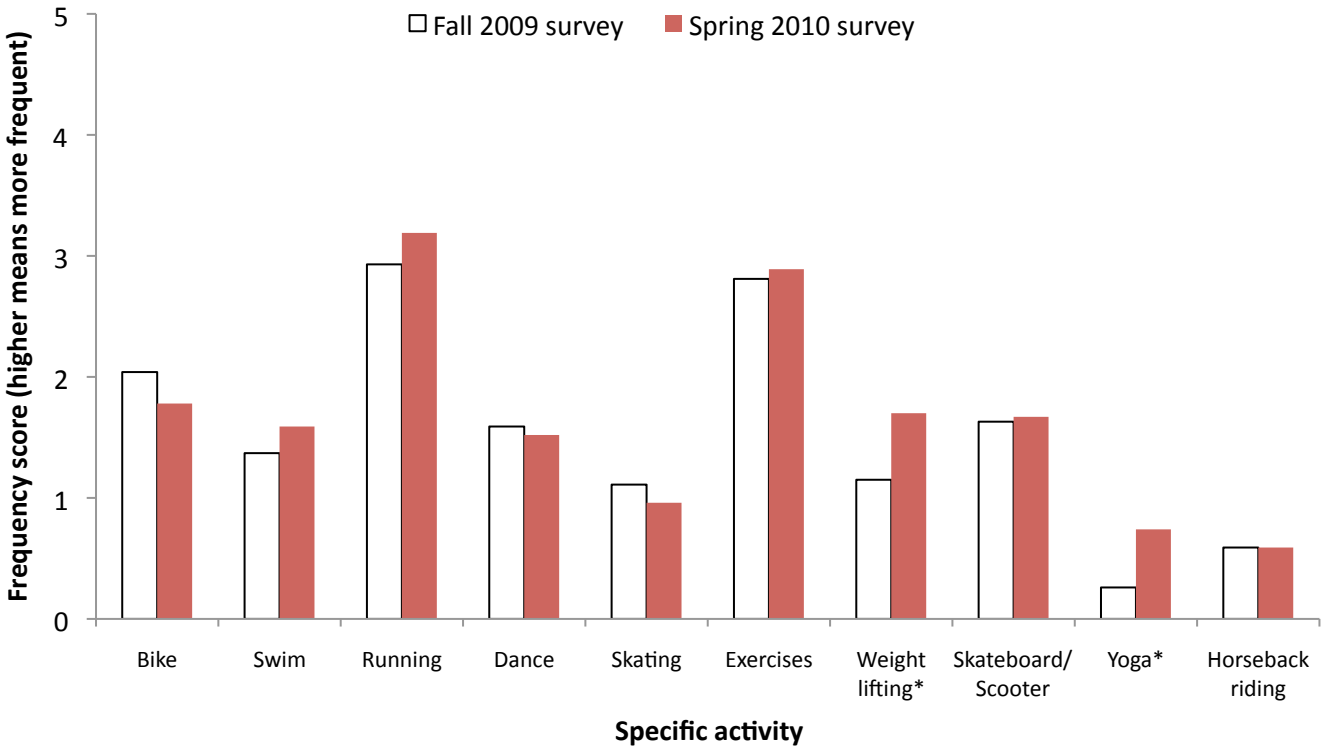

Figure 20. Frequency score for each activity, averaged for the fall 2009 and spring 2010 heats separately. A higher score indicates a higher frequency (1 = never and 5 = daily). The activities in which a significant difference was found between the two heats are marked with a star.

For all of the listed activities there was no significant difference between the frequency scores in the two heats except for weight lifting ($t(26) = 2.11$, $p < .05$, (two-tailed)) and yoga ($t(26) = 2.05$, $p = .51$, (two-tailed)). In both cases, these activities were more frequently done in the spring 2010 heat than in the fall 2009 heat, but it is unclear why this might be.

Organized physical activities

When asked how often in a typical week they practiced or played with a sports team, about two-thirds of respondents (65-69%) said they did so almost every day or a few times a week both during the fall 2009 and spring 2010 heats (see Figure 21). About one-fourth of the respondents in each heat said they were not on a sports team. There was no significant difference between the two heats on how frequently the respondents practiced or played with a sports team ($p > .05$).

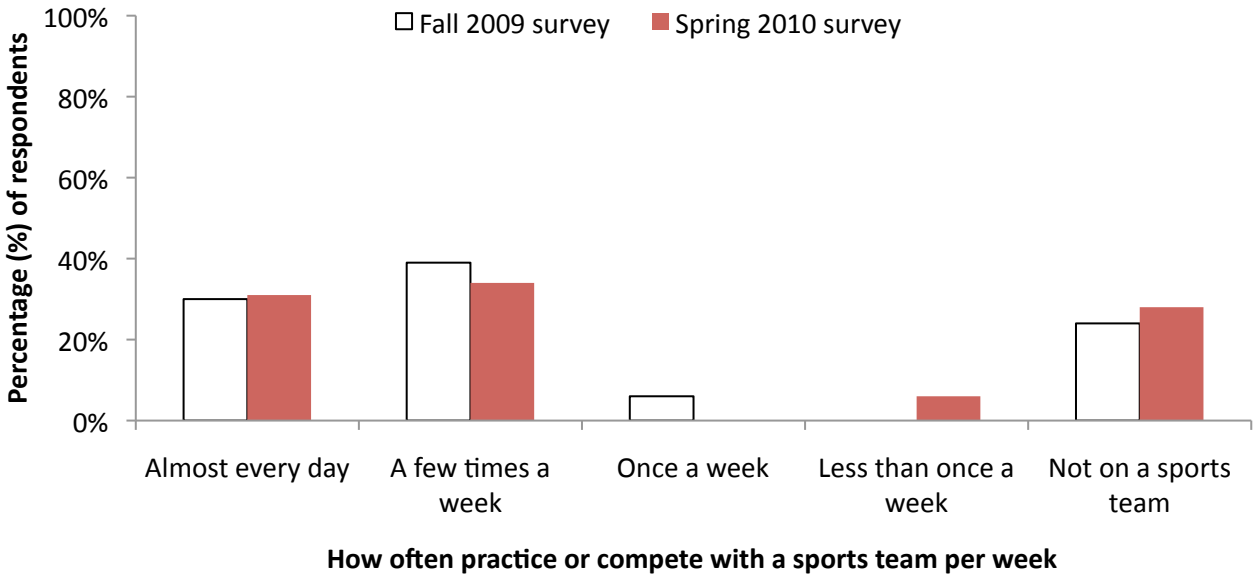

Figure 21. Percentage of respondents who practice or compete with a sports team at a certain frequency per week.

Respondents were asked to rate their agreement with statements about sports and competitive situations (see Figure 22). Their agreement with these statements was coded such that a higher agreement received a higher score. Generally, the respondents answered very similarly in the fall 2009 and spring 2010 surveys, agreeing with the statements "I think of myself as an athlete", "finishing a race is more important than winning", and "I am a competitive person", but disagreeing with the statement "playing sports and exercising is embarrassing". There was not a significant difference between the average agreement with these statements for the two heats ($p > .05$).

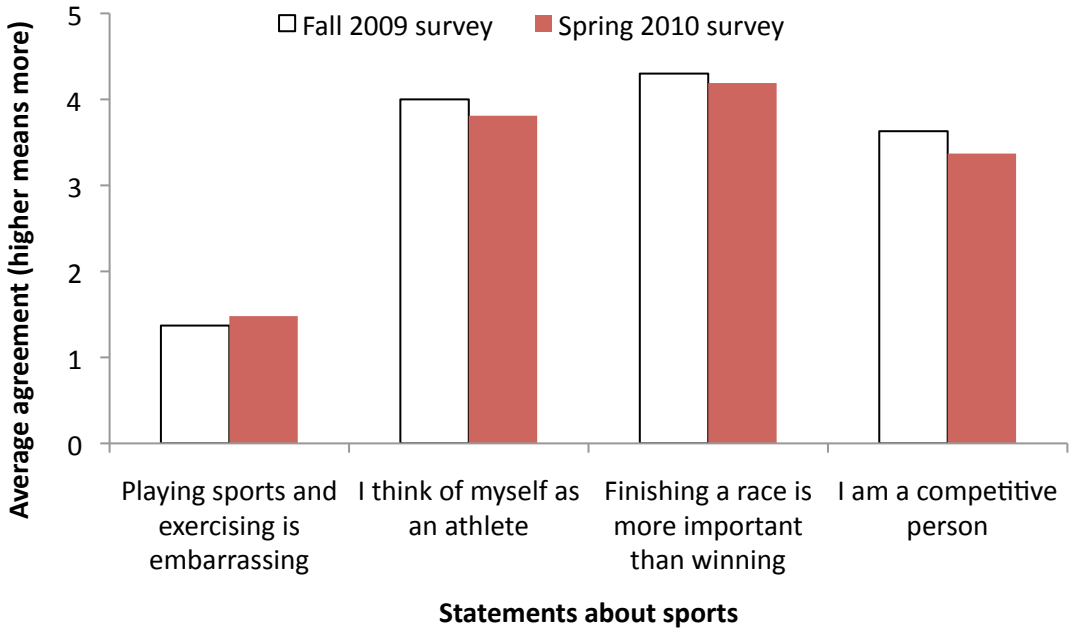

Figure 22. Average agreement with statements about sports and competitive situations in the fall 2009 and spring 2010.

In four different questions, the respondents were asked to choose between two opposite statements about self-efficacy in sports (e.g. “I do very well at all kinds of sports” and “I don’t feel I am very good when it comes to sports”). Figure 23 shows the percentage of respondent who chose the statement in each pair describing high self-efficacy in sports. In both heats, respondents generally chose the high self-efficacy statements over low self-efficacy statements. There was not a significant difference between the two heats on which statement was chosen, but there was a marginally significant difference for the statement “I feel I am good enough at sports” (the opposite statement was “I wish I could be a lot better at sports”, $t(31) = 1.97$, $p = .057$, (two-tailed)), with the respondents choosing the high self-efficacy statement of the pair more often in the fall than in the spring.

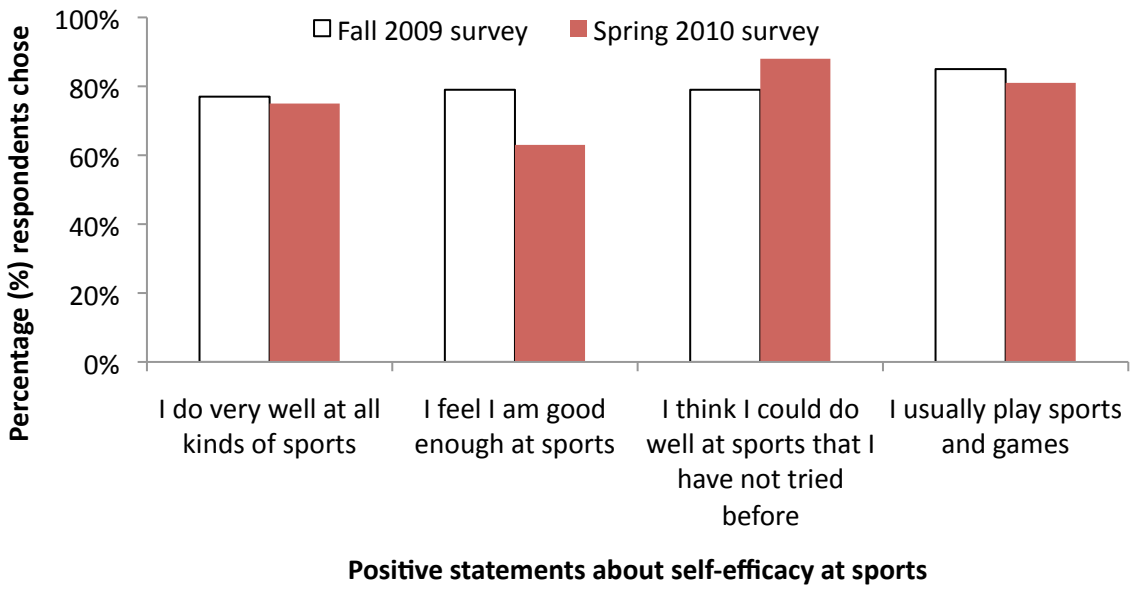

Figure 23. Average agreement with statements about sports and competitive situations in the fall 2009 and spring 2010.

The respondents were asked to rate how they felt about physical education classes on a five-point scale continuum, where one end of the scale represented a negative view (awful, frustrating, boring, and difficult) and the other a positive view (awesome, relaxing, fun, and easy). Generally, the respondents thought physical education class was awesome, relaxing, and fun in both heats and there was no difference in ratings between the two heats ($p > .05$; see Figure 24). There was a significant difference however on how easy or difficult the respondents rated physical education classes in the two heats ($t(31) = 2.25$, $p < .05$, (two-tailed)), with the respondents rating physical education classes as easier in the fall 2009 as compared to the spring 2010.

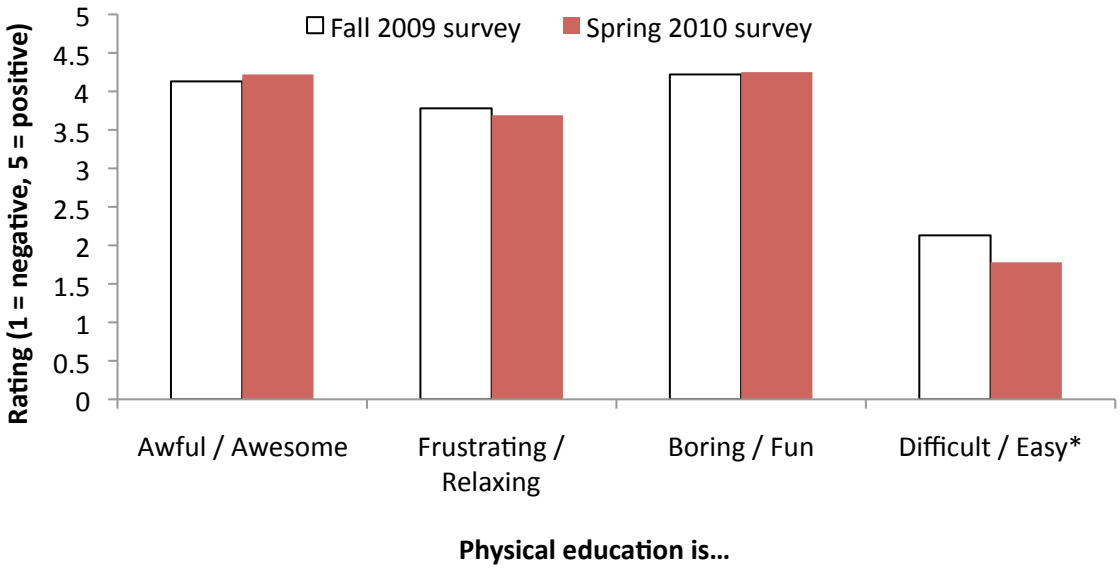

Figure 24. Average rating of physical education class on four different dimensions for the fall 2009 and spring 2010 heats. Lower numbers indicate the negative side of the dimension (awful, frustrating, boring, and difficult), whereas the higher numbers indicate the positive side of the dimension (awesome, relaxing, fun, and easy).Significant difference between the fall 2009 and spring 2010 heats is marked with a star.

Attitudes and feelings towards being physically active

The respondents were asked to rate how much they agreed or disagreed with statements on how being physically active made them feel. The response options ranged from “disagree a lot” to “agree a lot” on a five-point scale, and to summarize the average agreement the responses were coded such that a higher value indicated more agreement with the statement. Figure 25 shows the average agreement for the positive statements, whereas Figure 26 shows the results for the negative statements. Generally, the respondents overwhelmingly agreed with the positive statements on both survey occasions and there was no difference on the average agreement rating between the two heats. The respondents tended to disagree with the negative statements in both heats, and there was no significant difference in average agreement between the two heats except for the statement “when I’m physically active, it makes me sad” ($t(31) = -2.14$, $p < .05$, (two-tailed)), with the respondents agreeing with this statement more in the spring 2010 than in the fall 2009.

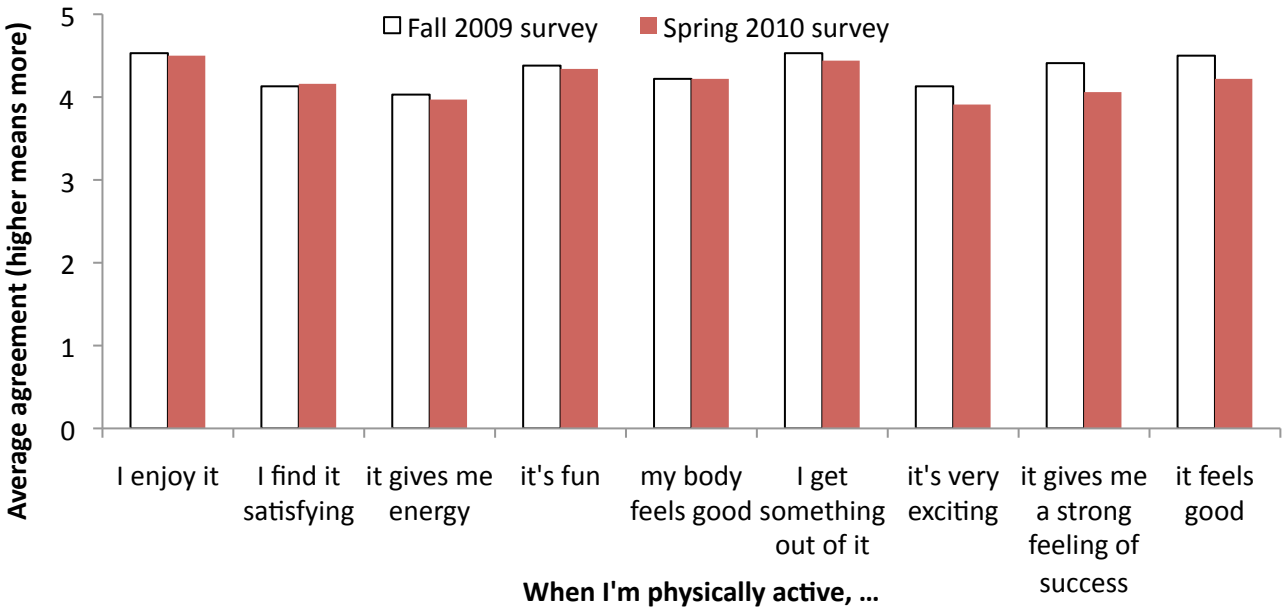

Figure 25. Average agreement with statements describing **positive** aspects of being physically active for the fall 2009 and spring 2010 surveys.

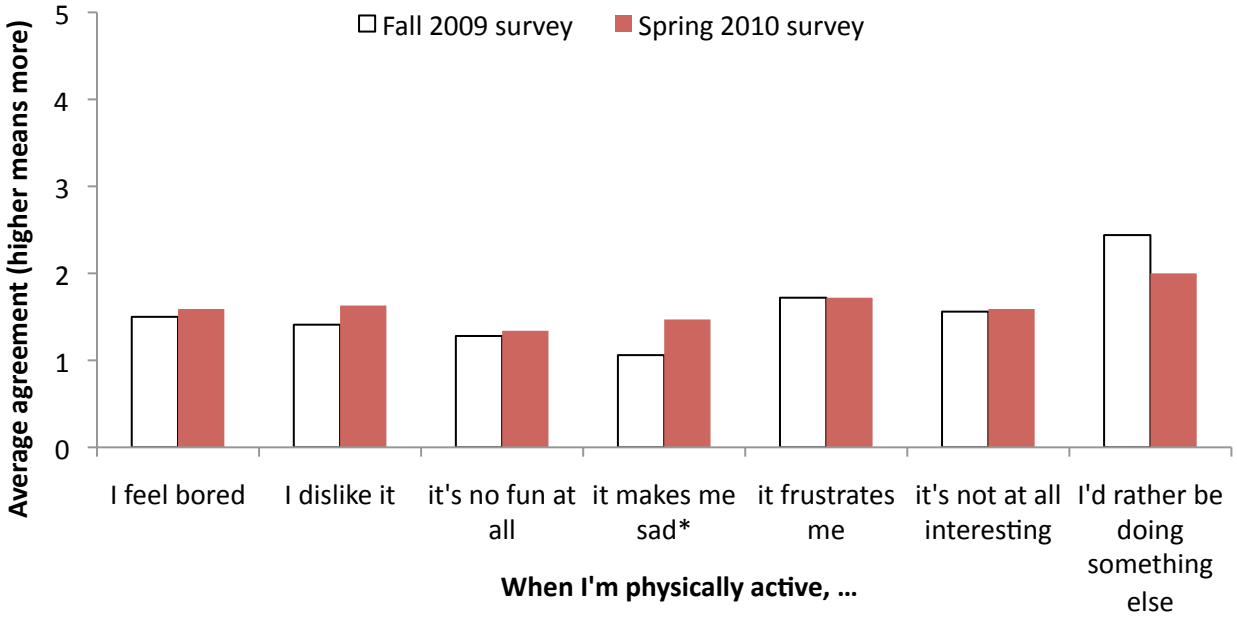

Figure 26. Average agreement with statements describing **negative** aspects of being physically active for the fall 2009 and spring 2010 surveys. Significant difference between the fall 2009 and spring 2010 heats is marked with a star.

The respondents were asked to rate how they felt about physical activities that made them tired or sweat on four different dimensions: Awful-awesome, frustrating-relaxing, boring-fun, and difficult-easy. On all the rating scales, the number one represented the most negative option and five represents the most positive option.

Overall, respondents felt that physical activities that made them tired or sweat were more awesome, relaxing, and fun than awful, frustrating, and boring (see Figure 27). However, the average on the difficult / easy dimension was 2.5, indicating that on average respondents considered physical activities that make them tired or sweat neither easy nor difficult. There was no difference in the ratings on any of the four dimensions between the fall 2009 and spring 2010 heats.

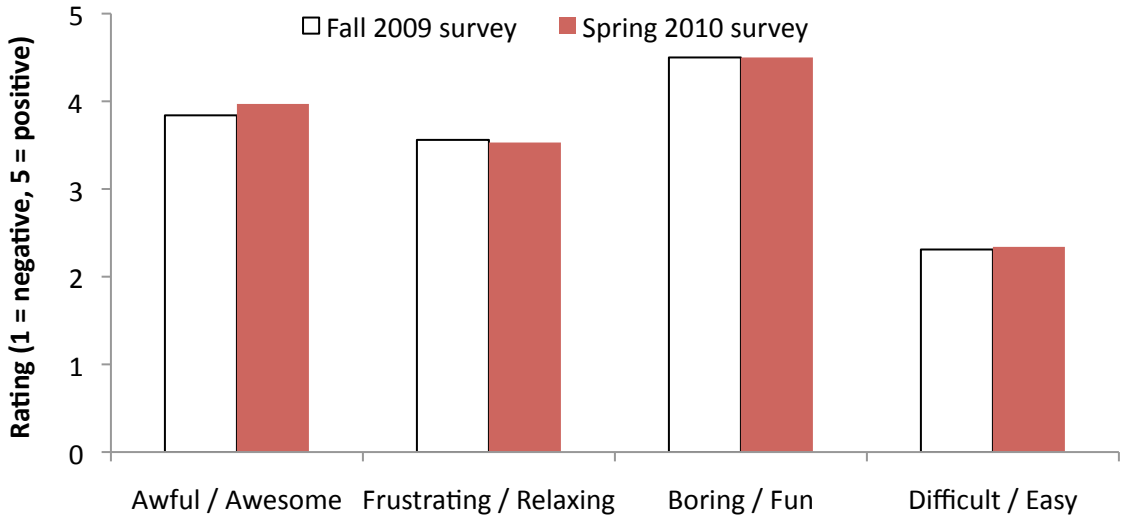

Figure 27. Average rating of physical activities on four different dimensions for the fall 2009 and spring 2010 heats. Lower numbers indicate the negative side of the dimension (awful, frustrating, boring, and difficult), whereas the higher numbers indicate the positive side of the dimension (awesome, relaxing, fun, and easy).

Social context and support

Respondents were asked how much they agreed or disagreed with the statements "my family is physically active" and "my friends are physically active". The answers were coded such that a higher score indicated more agreement (see Figure 28). The respondents tended to consider their friends more

physically active than their families, but there was no difference between the two heats on the average agreement with these statements ($p > .05$). These results are similar to the findings for the first phase.

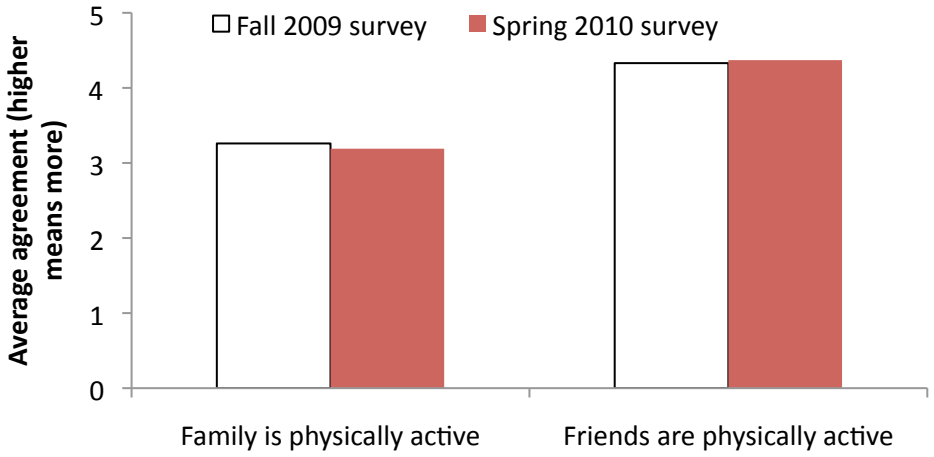

Figure 28. Average agreement with the statements that family and friends are physically active. A higher score indicates more average agreement.

Respondents were asked about the social support their families, friends, and teacher provided in helping them be physically active. The respondents answered how often their families, friends, or teacher did things like exercise with them, offered to exercise with them, discussed exercise with them, complained about the time needed to exercise, helped plan activities around their exercising, etc. There were 13 questions the respondents answered for each social group (family, friends, and teacher) respectively. To aggregate the results a social support index was created for each group by turning around statements 7 (complained) and 8 (criticized), and then aggregating the response for all statements (code: 1 = not at all, 5 = very often). This means that the higher the index, the higher the social support. The lowest value of the index could be 13 (answered all statements "not at all") and highest could be 65 (answered all statements "very often").

The respondents reported a similar level of social support for being physically active from their family and friends on both survey occasions, but the teacher's average social support was reported as being significantly higher in the spring 2010 heat compared to the fall 2009 heat (see Figure 29).

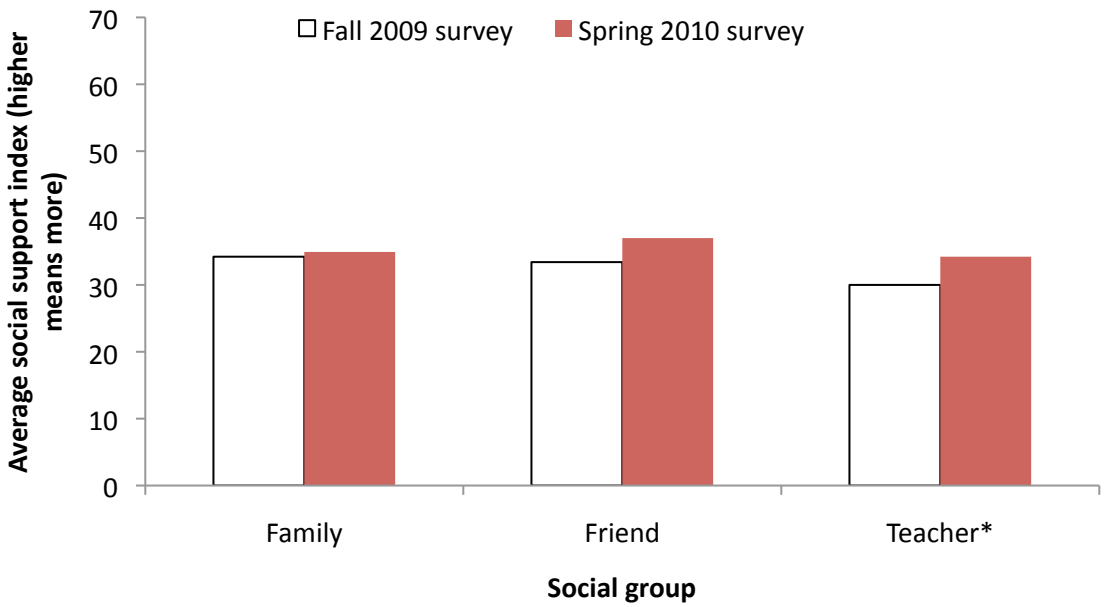

Figure 29. Average social support index per heat for family, friends, and teacher. A higher score indicates more social support for being physically active (lowest possible score is 13 and highest is 65). A significant difference between the fall 2009 and spring 2010 heat is indicated with a star.

Main Findings of Each Heat

As the results of the surveys in each individual heat have been presented in detail on prior occasions, we will briefly summarize the main findings here for the parts having to do with the student physical activities and their attitudes and feelings towards being physically active.

Throughout the three heats, 654 surveys were answered, representing 577 student participants in 39 different schools. In the spring 2009 a total of 314 student surveys were returned, 210 surveys were returned in the fall 2009, and 130 surveys were returned in the spring 2010. The number of surveys returned therefore declined in the course of the Challenge.

The student survey was changed after the spring 2009 heat and before being used in the fall 2009 heat. The reasons for these changes are provided in the section on methods, but the changes meant that the results for the spring 2009 heat and the last two heats are in some ways different as a consequence. The redesigned survey allowed us to collect more detailed data on activities.

The main findings of the student surveys for physical activities in each heat are grouped into three categories: 1) General physical activity, which reflects how physically active the student respondents say they are overall, 2) specific physical activities, which describes the specific activities the students do and the frequency with which they do them, and 3) attitudes and feelings towards being physically active, which summarizes the results from questions concerning how the students view physical activities and how they feel while being physically active.

STUDENT SURVEY RESULTS IN SPRING 2009

General physical activity

The survey results from the spring 2009 heat did not give a good picture of the general activity level of the students because of how the questions were structured. However, when we divided the activities the students said they did at least once a week into high and low intensity activities, we found that the students did a higher proportion of activities categorized as low intensity activities at least once a week, than high intensity activities. In addition, girls on average reported doing a higher number of the low intensity activities at least once a week as compared to the boys, but no gender difference was found for the high intensity activities.

Specific physical activities

When it came to specific activities, the majority of students reported that they help clean up the house, play sports, walk and play outside at least once a week. Other activities that the students most commonly did at least once a week and were categorized as low intensity activities were watching TV or DVD's, using the Internet, talking on the phone, and talking with parents or guardians. All these activities were done at least once a week by over two thirds of the student respondents.

We also found gender differences for many of the listed activities, for example, it was more common that girls clean the house and walk outside, whereas it was more common that boys played sports at least once a week.

The students were also asked to rate how much they liked different activities. Generally, the students reported liking most activities; however, when the activities were divided into low and high intensity categories, more students reported liking the low intensity activities as compared to the high intensity activities. It is however noteworthy that the respondents generally did not express dislike of any

activities, for example they tended to be more neutral than negative towards the high intensity activities. Girls tended to express more liking for both low and high intensity activities than boys did.

Attitudes and feelings towards being physically active

The students returning surveys overwhelmingly report positive attitudes towards being physically active – even *before* starting AHPC. They were asked to rate how much they agreed with statements describing either positive or negative feelings towards being physically active. More than half of the respondents said that they either "agreed" or "agreed a lot" with the positive statements and "disagreed" or "disagreed a lot" with the negative statements.

This finding raised the issue whether the positive attitude was due to the type of students recruited into the AHPC (e.g. whether the schools recruited a random sample or used students motivated to be physically active such as athletes) or whether it was due to influences of social desirability, that is, the students were answering as they thought they should answer and not as they really felt. Either way, we seemed to have a ceiling effect on positive attitudes towards being physically active.

STUDENT SURVEY RESULTS IN FALL 2009

General physical activity

The students were asked to report how frequently they did strenuous, moderate, and mild exercises for at least 15 minutes per week. In all cases, the most common responses were five times a week and 10 times a week or more. For strenuous and moderate exercises a likely reason is that respondents often have physical education classes once a day during the week, and many who participate in sports (which are the majority of respondents) practice once a day.

Overall, boys reported doing strenuous and moderate exercises more often per week than girls, but there was no difference between girls and boys on how frequently they did mild exercises. The majority of respondents characterized their general physical activity level as high or very high and only 7% characterized it as low or very low. Boys tended to characterize their activity level higher than girls did. About half the respondents said that they were about as active as others in their same age group and 40% said they were more active.

Specific physical activities

The most common physical activities were walking, running, playing outdoors, doing exercises, doing indoor chores, playing basketball, and playing active games. About two thirds of the respondents said that they did these activities at least weekly or daily. The least common activities were horseback riding, hockey, yoga, cheerleading, and playing in a marching band. A few activities were notably done on a seasonal basis (a few times a year): playing in water, swimming laps, fishing, and camping. Gender differences were found for some activities (for example, playing Nintendo Wii or Dance Dance Revolution, playing ball, doing outdoor chores, weight lifting, and playing football) and most often boys did those activities more frequently (with the exception of dancing or cheerleading which girls did more often).

When the overall number of activities that the respondents reported doing frequently (at least daily or weekly) was added up, it turned out that boys generally do more activities (of those listed) frequently than girls. One reason for this could be that the activities listed generally appeal more to boys than girls, but the reason could also be that boys tend to do more variety of physical activities as compared to girls.

Attitudes and feelings towards being physically active

The respondents generally described themselves as being good at sports, as the majority chose statements describing high efficacy in sports when asked to choose between statements describing either high or low self-efficacy in sports. A gender difference was found for only one of the questions, with girls being more likely to choose the statement "I don't feel I am very good when it comes to sports" over boys, but the majority of girls (80%) still chose the opposite statement ("I do very well at all kinds of sports").

Overall, the majority of respondents chose statements describing good self-image over statements describing poor self-image, especially when the statements referred more to character than explicit outward appearance. The only question that revealed a gender difference referred to weight. Girls reported more unhappiness with their weight than boys did. Even so, 60% of girls said they were happy with their weight.

The respondents were asked to rate on four different scales how they felt about physical activities that make them tired or sweat. The possible responses ranged from negative (i.e., awful, frustrating, boring,

and difficult) to positive (i.e., awesome, relaxing, fun, and easy). Generally, the respondents rated physical activities as more positive than negative, but there was a gender difference in that girls tended to rate physical activities more negatively than boys (with the exception of difficult-easy continuum where there was no difference).

The respondents were asked to rate in the same manner how they felt about physical education classes, and again the results showed overall positive feelings. However, girls were more likely to rate physical education classes more negatively than boys (with the exception of difficult-easy continuum where there was no difference).

When asked to rate how much they agreed or disagreed with statements of how physical activity makes them feel, the respondents expressed an overwhelmingly positive view, but girls tended to express a less positive view than boys towards physical activity.

STUDENT SURVEY RESULTS IN SPRING 2010

General physical activity

When asked to rate the frequency with which they practice mild, moderate, or strenuous physical activity, most respondents said that they exercise either 2-5 times a week or 10 times or more per week. The respondents exercising 10 times or more each week are likely the more active students who practice sports in addition to taking physical education classes. No correlation was found between number of steps logged in the AHPC and self-reported frequency of physical activity. Boys turned out to report moderate and strenuous exercise more frequently than girls did, but there was no difference between genders on the reported frequency of doing mild exercise.

About half of the respondents described their general physical activity level as high or very high and only 4% described it as low or very low. Respondents who rated their physical activity level higher were also more likely to log more steps in the AHPC, but this correlation was not significant. Boys were more likely to report a higher physical activity level than girls.

Half of the respondents reported their physical activity level as being on a par with other people their age, and a third reported it being higher. There was no correlation between how the respondents compared themselves to people their age and the number of steps logged in the AHPC, and there was no difference between the genders on how they compared themselves to others their age.

Specific physical activities

When asked to indicate the context in which their physical activities take place, most respondents said that they do activities in the company of family or friends, while basketball, baseball/softball, soccer, and running were the activities that were most commonly practiced with a competitive team, and dance and exercises were the activities most commonly done in classes or while taking lessons. Gender differences were found for a few of the listed activities: girls were more likely to practice dance, yoga, horseback riding, and cheerleading, whereas the boys were more likely to lift weights and do combative sports.

Two thirds of the respondents were on a sports team and most practiced at least a few days a week, indicating that the majority of respondents were quite physically active. Boys were found to practice or compete with a sports team more frequently than girls, but girls and boys were just as likely to be on a sports team.

The activities that the respondents most frequently did were walking, running, indoor chores, exercises, outdoor play, basketball, and active games, with about two thirds of respondents doing these activities at least weekly. The respondents seldom went horseback riding, practiced yoga, hockey, cheerleading, or played on a marching band as about half of respondents said they never did these activities. Girls were more likely to practice cheerleading and dancing whereas boys were more likely to go skateboarding, play Wii or DDR, lift weights, play football, build things, and ball games. Generally, boys tended to report a higher number of activities frequently (weekly or daily) as compared to girls, but this difference was not significant.

Attitudes and feelings towards being physically active

Overall, the respondents had a high self-efficacy in sports, indicating that they believe themselves to be good at sports (whether or not they had tried them before) and willing to participate. The majority of respondents with high self-efficacy in sports played or practiced with a sports team, but respondents with lower self-efficacy were just as likely to be on a sports team as not. There was no significant difference between girls' and boys' self-efficacy in sports.

Generally, the respondents had a good self-image, especially when it came to qualities referring to character rather than outward appearance. There was no overall difference between girls and boys on

self-image, but boys tended to agree more with the statement "I am often unhappy with myself" than girls.

When asked to evaluate physical activities that made them tired or sweat using scales with a continuum from positive to negative descriptions (e.g., awesome – awful), respondents overall felt that physical activities were more awesome, relaxing, and fun than awful, frustrating, and boring. However, the respondents thought that physical activities that made them tired or sweat were more difficult than easy. Girls were more likely to rate physical activities more negatively than boys, except on the scale boring-fun.

Respondents also evaluated physical education classes on the same scales, and generally rated them positively, i.e. more awesome, relaxing, and fun, than awful, frustrating, and boring. The respondents considered physical education class more difficult than easy however. Girls were more likely than boys to rate physical education classes as more frustrating.

The respondents were asked to rate how much they agreed or disagreed with different statements of how being physically active made them feel. The respondents seemed to have overwhelmingly positive feelings towards being physically active and no difference was found when comparing how girls and boys felt about being physically active.

Comparison across Heats

We collected survey data from the student in all three heats, and even if the survey changed between the first (spring 2009) and the second (fall 2009) heats, the survey results across the three heats can be compared on certain questions. It has to be kept in mind though that some participants continued in the Challenge between heats, whereas others participated only in one heat. Any differences found cannot therefore be attributed to only long-term changes or only differences in cohorts, but rather to some combination of the two in addition to other possible influences such as school schedule for curriculum and sports, teacher enthusiasm and willingness to engage with the AHPC over time, and technical issues and support (to name just a few).

In the reports on the survey results from each heat the demographic characteristics of the participants in described in more detail, here we will only summarize the main characteristics (see Table 4).

Table 4.

Number of student AHPC participants that answered surveys in both the spring 2009 and fall 2009 heats.

Survey	Nr of respondents	% of total (N = 654)	% Girls	Most common age	Nr of schools*	Mean nr of steps
Spring 2009 survey	314	48%	56%	12 years	20	89108
Fall 2009 survey	210	32%	48%	12 years	19	82314
Spring 2010 survey	130	20%	52%	12-13 years	22	82906

* Refers to the number of schools returning surveys in that heat.

The comparison of the survey results of the three heats will focus on two categories of questions concerning the student physical activity level: Their general physical activity level and their attitudes and feelings towards being physically active.

GENERAL PHYSICAL ACTIVITY

In all three heats, the respondents were asked whether they agreed or disagreed with statements about health and general physical activities. To provide an overview of the level of agreement with these statements, the answer options were coded from 1 through 5 where 1 represented the least amount of agreement and 5 the most. The answers were then averaged for each heat (see Figure 30).

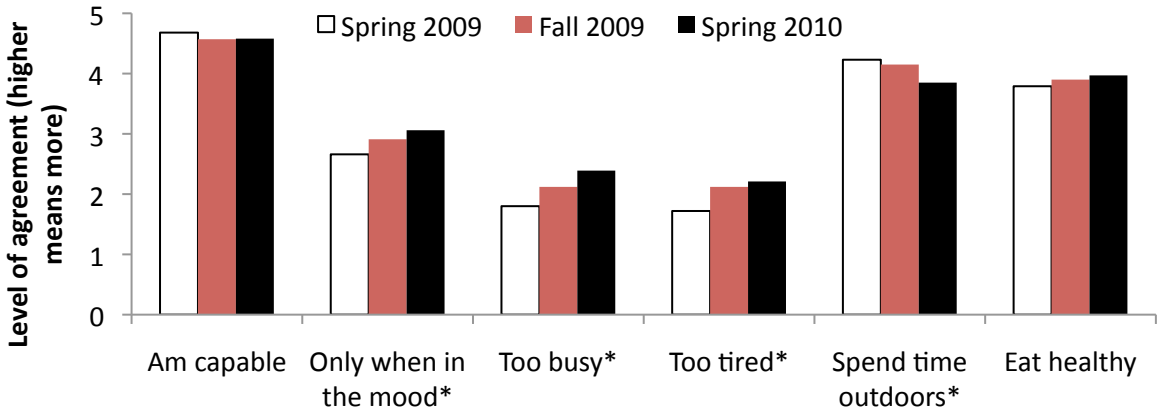

Figure 30. Average level of agreement with statements concerning general physical activities and health, a higher score indicates more agreement with the statement. The statements where a significant difference was found among the three heats are marked with a star.

There was a significant difference found among the three heats for four of the statements: “I’m only physically active when I’m in the mood for it” ($F(2,596) = 3.79$, $p < .05$), “I’m usually too busy for physical activity” ($F(2,596) = 10.09$, $p < .001$), “I’m usually too tired for physical activity” ($F(2,593) = 3.35$, $p < .001$), and “I spend a lot of time outdoors” ($F(2,596) = 4.68$, $p < .05$).

For the first three statements the agreement increased with each heat, and a post-hoc comparison with Tukey’s *HSD* showed that the difference was significant between the spring 2009 survey and the spring 2010 survey ($p < .05$ in all cases) and between the spring 2009 and fall 2009 surveys for the statements “too busy” and “too tired” ($p < .05$). For the last statement, the agreement decreased with each heat, and a post-hoc comparison showed that the difference was between the spring 2009 and spring 2010 surveys. This means that overall the respondents seemed less enthusiastic for physical activities with time, especially going from the spring 2009 to the fall 2009.

In the last two heats (fall 2009 and spring 2010) the respondents were asked to quantify how often a week they engaged in strenuous, moderate, or mild exercise for at least 15 minutes at a time (see Figures 31, 32, and 33). Generally, as the exercise got easier it became more common for participants to do it more often during the week.

For both survey occasions, the majority of respondents did strenuous exercise 1-6 times a week, but around 20% did so 10 times a week or more. These most likely reflect the students who practice sports in addition to physical education classes. There was no difference between the two survey occasions (fall 2009 and spring 2010) on how often the students did strenuous exercise for at least 15 minutes per week ($p > .05$).

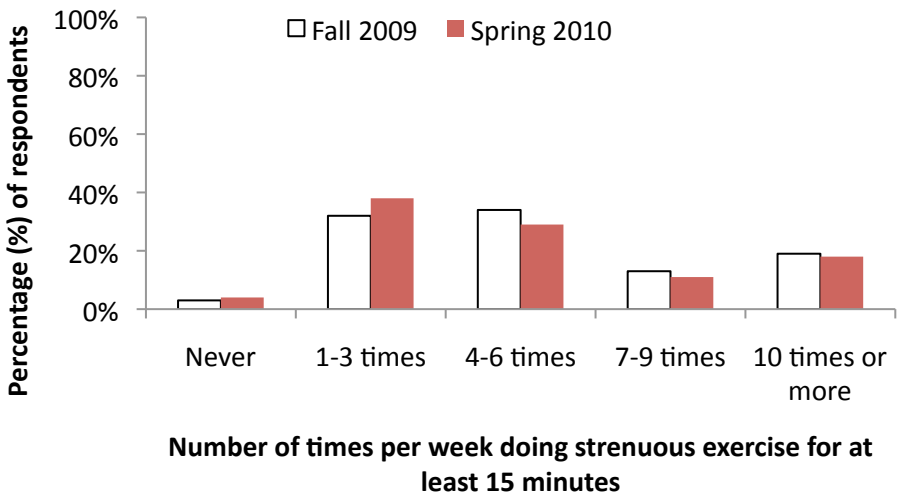

Figure 31. Percentage of students who report doing strenuous exercise for a specified number of times per week for at least 15 minutes at time in the fall 2009 and spring 2010.

When asked about moderate exercise, about 40% of respondents on both survey occasions said they do moderate exercise for at least 15 minutes 4-6 times a week. There was a significant difference between the two survey occasions on how often on average the students said they do moderate exercise for at least 15 minutes per week ($F(1,318) = 4.51$, $p < .05$), with the respondents generally doing moderate exercise more often in the fall 2009 than spring 2010.

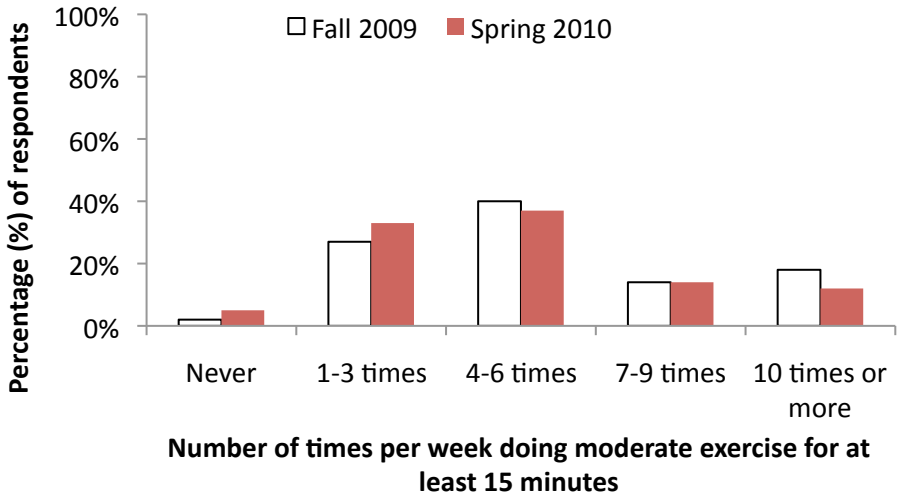

Figure 32. Percentage of students who report doing moderate exercise for a specified number of times per week for at least 15 minutes at time in the fall 2009 and spring 2010 heats.

On both survey occasions approximately equal percentage of students did mild exercise 1-3 times, 4-6 times, and 10 times or more per week. There was no difference between the two survey occasions (fall 2009 and spring 2010) on how often the students did strenuous exercise for at least 15 minutes per week ($p > .05$).

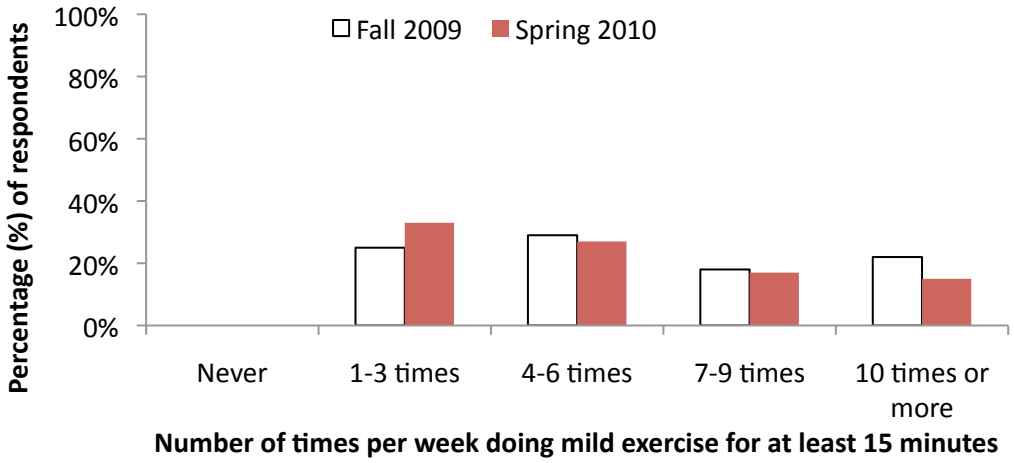

Figure 33. Percentage of students who report doing strenuous exercise for a specified number of times per week for at least 15 minutes at time in the fall 2009 and spring 2010 heats.

When asked about their general activity level on most days, the majority of respondents rated it as medium or high on both survey occasions, fall 2009 and spring 2010 (see Figure 34). There was no difference in how high the respondents rated their general activity level on the two survey occasions ($p > .05$).

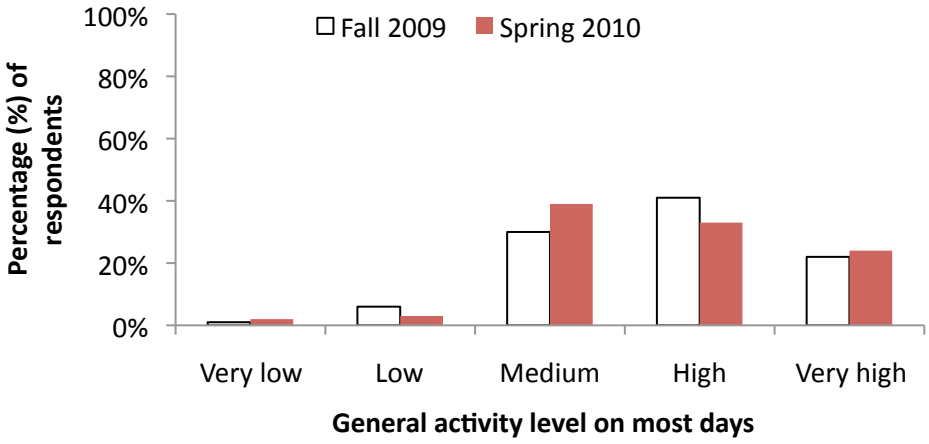

Figure 34. Percentage of respondents who describe their daily physical activity level as very low, low, medium, high, or very high in the fall 2009 and spring 2010.

About two thirds of the respondents rated their general activity level on most days as about the same as other peoples their age on both survey occasions (see Figure 35). Only a few percentages of respondents rated their own general activity level as less than other people their age. There was no difference between the two survey occasions on how the respondents rated their general activity level compared to others their age ($p > .05$).

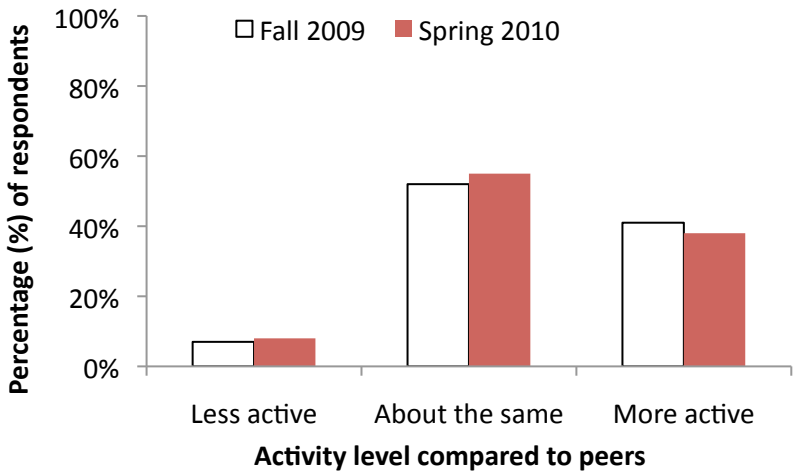

Figure 35. Percentage of respondents who describe their general activity level as less, about the same, or more active than other people their age in the fall 2009 and spring 2010.

ATTITUDES AND FEELINGS TOWARDS BEING PHYSICALLY ACTIVE

The students rated how much they agreed or disagreed with statements on how they felt when physically active. The response options ranged from "disagree a lot" to "agree a lot" on a five-point scale, and to summarize the average agreement the responses were coded such that a higher value indicated more agreement with the statement. Figure 36 shows the average agreement for the positive statements, whereas Figure 37 shows the results for the negative statements.

Generally, the students overwhelmingly agreed with the positive statements on all three survey occasions. There was a significant difference in average agreement among three heats for two of the positive statements: "when I'm physically active, I get something out of it" ($F(2,625) = 4.71$, $p < .05$) and "when I'm physically active, it gives me a strong feeling of success" ($F(2,622) = 5.04$, $p < .05$). Tukey's *HSD* post-hoc tests showed that for the first statement the students in the spring 2009 heat tended to agree with it less than in the other two heats, and for the second statement the students in the spring 2009 heat agreed with it less than the students in the fall 2009 heat.

The students generally disagreed with the negative statements on all three survey occasions. There was a significant difference in average agreement among the three heats for one of the negative statements: "when I'm physically active, I dislike it" ($F(2,618) = 3.73$, $p < .05$). A post-hoc test with Tukey's *HSD* showed that the students in the spring 2010 heat agreed with this statement more than students in in the fall 2009 heat.

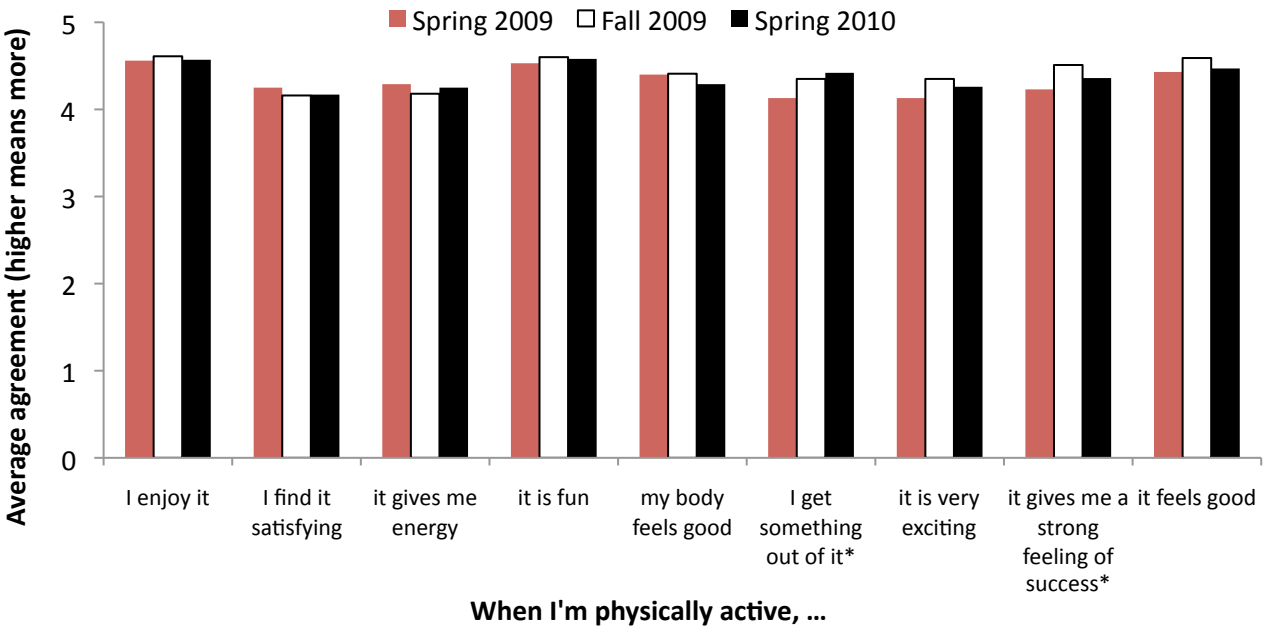

Figure 36. Average agreement with statements describing **positive** aspects of being physically active for the three survey occasions. Statements where significant difference among the three heats was found are marked with a star.

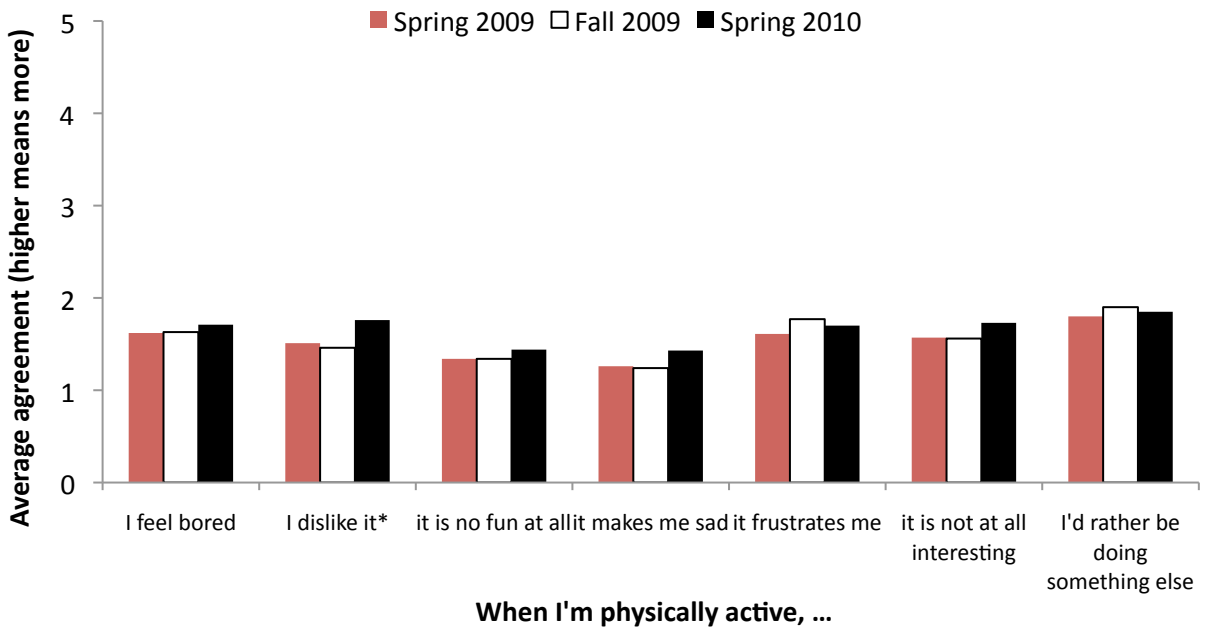

Figure 37. Average agreement with statements describing **negative** aspects of being physically active for the three survey occasions. Statements where significant difference among the three heats was found are marked with a star.

The respondents were asked to rate how they felt about physical activities that made them tired or sweat on four different dimensions: Awful-awesome, frustrating-relaxing, boring-fun, and difficult-easy. On all the rating scales, the number one represented the most negative option and five represented the most positive option.

Overall, respondents felt that physical activities that made them tired or sweat were more awesome, relaxing, and fun than awful, frustrating, and boring (see Figure 38). However, the average on the difficult / easy dimension was 2.5, indicating that on average respondents considered physical activities that make them tired or sweat neither easy nor difficult. There was no difference in the ratings on any of the four dimensions among the three survey occasions ($p > .05$).

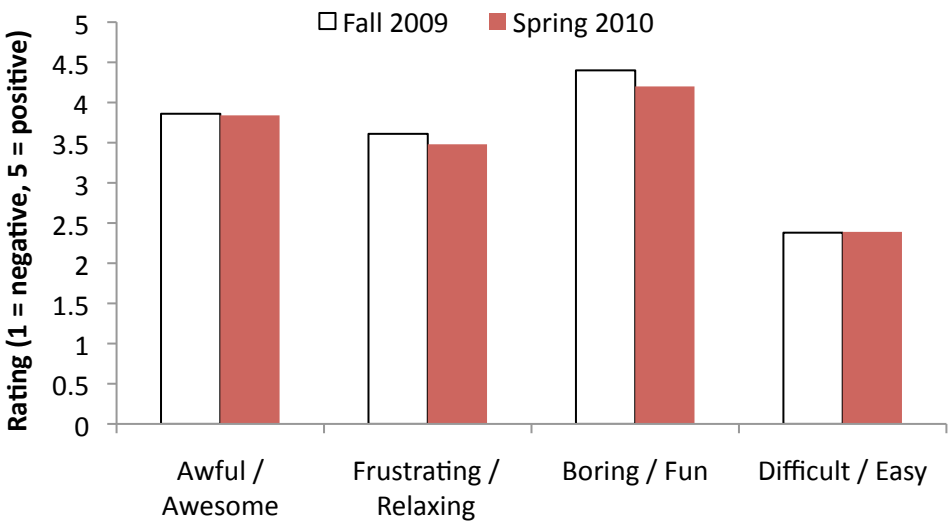

Figure 38. Average rating of physical activities on four different dimensions for the three heats. Lower numbers indicate the negative side of the dimension (awful, frustrating, boring, and difficult), whereas the higher numbers indicate the positive side of the dimension (awesome, relaxing, fun, and easy).

Correlation with Steps

We wanted to investigate to what degree the self-reported physical activities and attitudes and feelings towards physical activities correlated with the number of steps the students accumulated during the AHPC. To do so we looked at the correlation between number of steps and some main indices of the three categories explored in this chapter: general physical activity level, specific physical activities, and attitudes and feelings towards being physically active. As these categories had the same exact questions in the surveys used in the last two heats, we used the aggregated survey responses from these two heats to correlate with steps.

GENERAL PHYSICAL ACTIVITY LEVEL

Students had indicated in the survey how often in the course of a general week they engaged in a strenuous, moderate, or mild physical activities for at least 15 minutes at a time, and they could select answer options ranging from “never” to “10 times or more”. The answer options were coded such that a higher number corresponded with a higher frequency and the answers were then correlated with the number of steps logged during the two heats (fall 2009 and spring 2010).

There was not a significant correlation between number of steps and frequency of doing strenuous or moderate activities in a week (strenuous: $r = -.013$, $p > .05$; moderate: $r = -.012$, $p > .05$), and in both cases the correlation was very low. However, we did find a significant correlation between the frequency with which the students engaged in mild activities in a week and the number of steps ($r = -.16$, $p < .05$). What is surprising is that this correlation is negative, indicating that the students who said they engage in mild physical activities less often in a week actually tended to have more steps than those who said they engage in mild physical activities more often per week (see Figure 39). The reason for this finding is not clear, but to verify that this was not due to the students who had had trouble with their pedometers and not logged any steps we redid the analyses this time without including cases where zero steps had been logged. The results turned out the same way; non-significant low negative correlations for strenuous and moderate physical activities, and a significant negative correlation ($r = -.15$, $p < .05$) for mild physical activities.

Generally, it therefore seems that the self-reported frequency of doing strenuous and moderate physical activities in a week is not a indicator of the number of steps the students are likely to log in the AHPC, and in the case of mild physical activities, the opposite is the case: The higher frequency with which the students say they engage in mild physical activities per week predicts fewer steps logged with the pedometer.

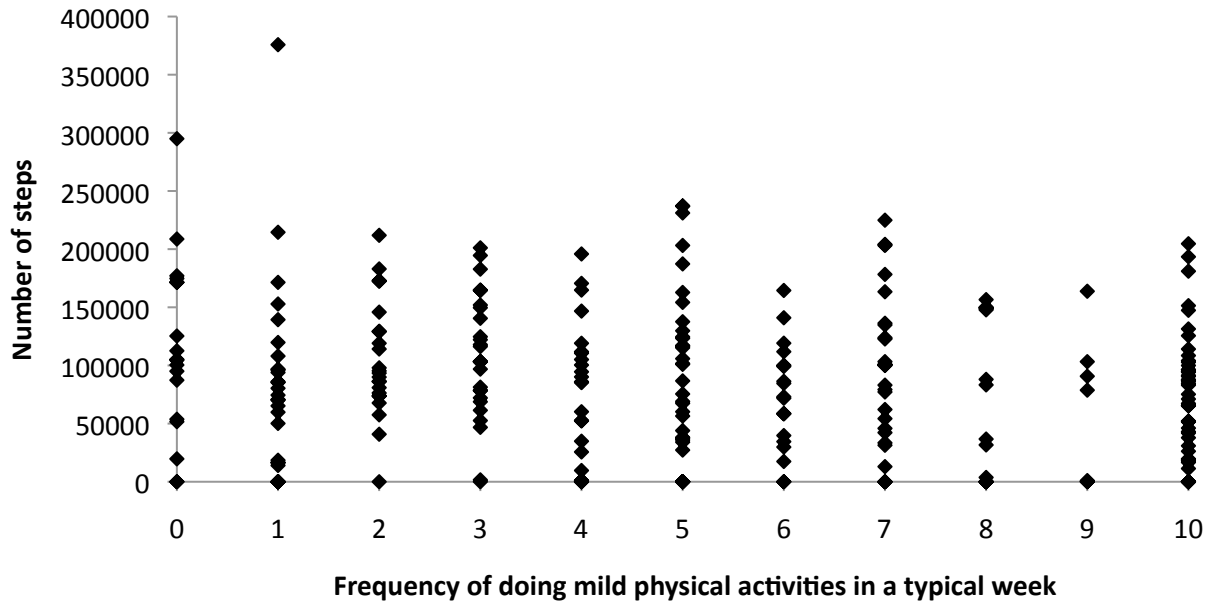

Figure 39. Scatterplot showing the self-reported frequency of engaging in mild physical activities for at least 15 minutes at a time in a week plotted against the number of steps logged by each student returning the survey in the two later heats (fall 2009 and spring 2010).

The students were asked to rate their *general* physical activity level on the scale from "very low" to "very high". The answer options were then coded such that a higher number indicated a higher physical activity level and then correlated with the number of steps.

We found a significant positive correlation ($r = .30$, $p < .001$), indicating that as the students rated themselves with a higher general activity level, the more likely they were to log a higher number of steps with the pedometer in the AHPC (see Figure 40).

Therefore, asking students to rate their general activity level seems to predict to some degree the number of steps they accumulate during the AHPC.

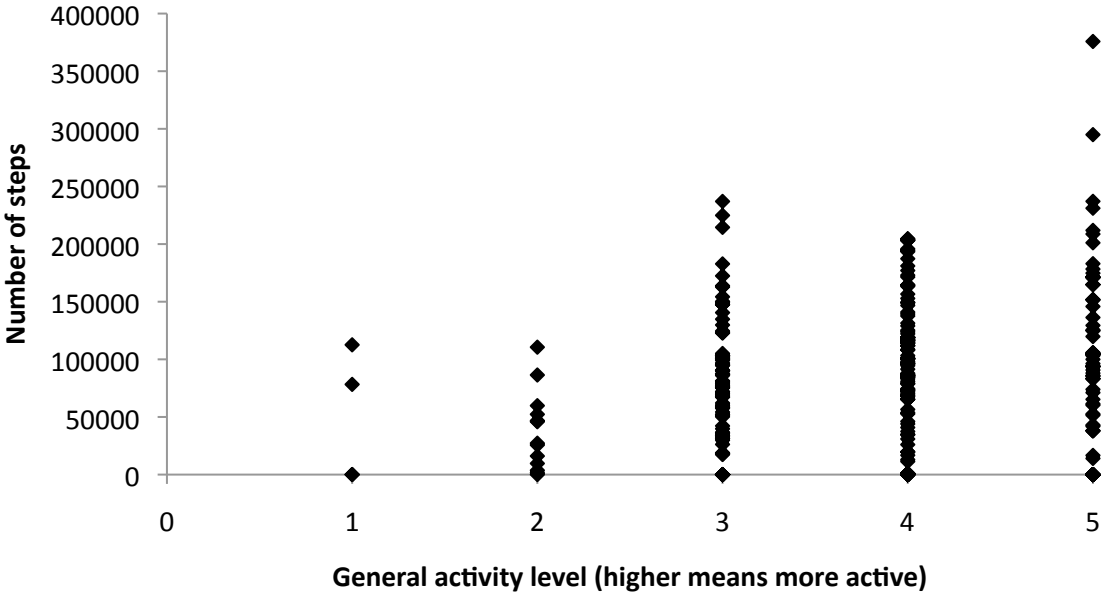

Figure 40. Scatterplot showing the self-reported general activity level (higher means more active as 1 = "very low" and 5 = "very high") plotted against the number of steps logged by each student returning the survey in the two later heats (fall 2009 and spring 2010).

SPECIFIC PHYSICAL ACTIVITIES

In the surveys the students were asked to indicate the frequency by which they did listed physical activities, such as biking, walking, swimming, and baseball. The answer options were then coded such that a higher number indicated a higher frequency of doing the activity in question (e.g., 1 = "never", 5 = "at least daily"). The frequency of each activity was then correlated with the number steps of the last two heats (fall 2009 and spring 2010).

Table 5 shows the correlation between frequency of activity and number of steps for each of the listed activities. There was a significant positive correlation for seven of the 32 activities: basketball, football, outdoor play, biking, building, soccer, and indoor chores, indicating that as these activities were done more frequently more steps were logged with the pedometers. Three activities had marginally significant positive correlation: active games, racket sports, and camping.

Table 5.

Correlation (and significance) between frequency of doing activity and number of steps logged in the AHPC during the last two heats (fall 2009 and spring 2010).The listed activities are order by order of correlation magnitude (i.e., ignoring the sign of the correlation) and significant correlations are shaded.

Activity	*r*	Significance
Basketball	.30	$p < .001$
Football	.25	$p < .05$
Outdoor play	.23	$p < .05$
Bike	.21	$p < .05$
Building	.20	$p < .05$
Soccer	.19	$p < .05$
Indoor chores	.17	$p < .05$
Active games	.15	$p = .07$
Racquet sports	.15	$p = .08$
Camping	.15	$p = .08$
Ballgames	.14	--
Exercise	.11	--
Combative sports	.11	--
Horseback riding	.11	--
Fishing	.11	--
Hockey	.10	--
Yoga	-.09	--
Wii & DDR	.07	--
Walking	.07	--
Skating	.07	--
Water play	.07	--
Skateboard & scooter	.07	--
Outdoor chores	-.06	--
Gymnastics	.05	--
Lift weights	.05	--
Cheerleading	-.05	--
Swim	-.05	--
Baseball	.04	--
Running	.04	--
Dance	.03	--
Walking the dog	-.03	--
Hiking	.01	--

The students were asked how often they practice or play with a sports team and they could answer on the scale from “almost every day” to “not on a sports team”. The answer options were coded such that a higher number represented a higher frequency of practicing or playing on a sports team and then correlated with the number of steps. There was a significant positive correlation ($r = .18$, $p < .05$) indicating that as students practiced or played with a sports team more frequently, the more likely they were to log a higher number of steps (see Figure 41).

This correlation seems mostly due to the difference between students who are on a sports team and those who are not. When the frequency of practicing or playing with a sports team is correlated with steps without including students who are not on a sports team, the correlation drops to .09 and is not significant ($p > .05$). Therefore, it is not the frequency by which the students play or practice on a sports team that predicts number of steps, but whether they are on a sports team at all. This is also supported by the fact that most students who are on a sports team practice or play a few times a week or almost every day (scores 4 and 5 on Figure 41).

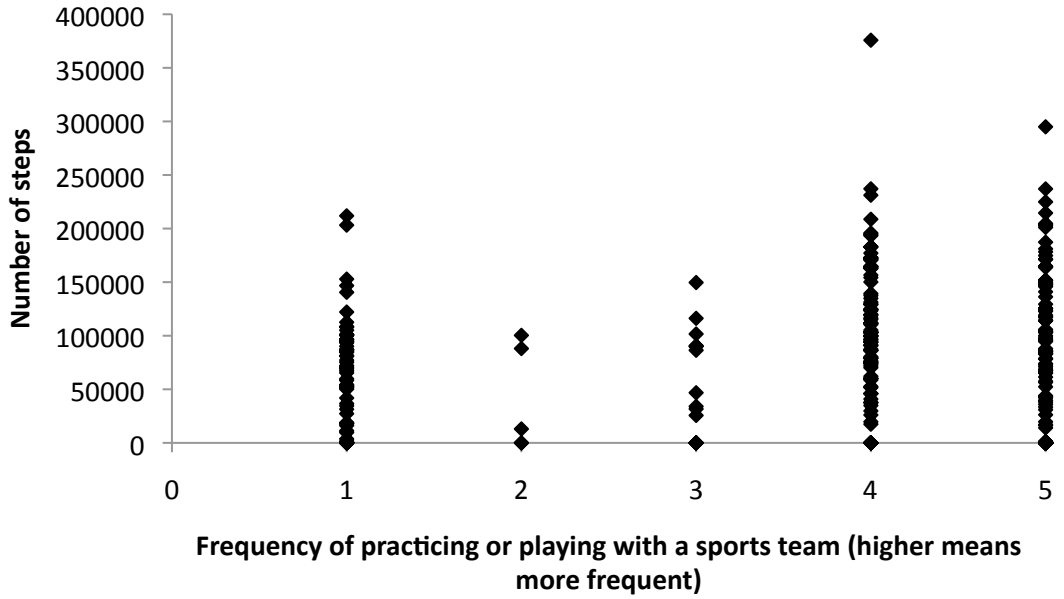

Figure 41. Scatterplot showing the frequency with which the students practice or play with a sports team (a higher score means more frequent as 1 = “not on a sports team” and 5 = “almost every day”) plotted against the number of steps logged by each student returning the survey in the two later heats (fall 2009 and spring 2010).

ATTITUDES & FEELINGS TOWARDS BEING PHYSICALLY ACTIVE

The students were asked to rate how much the agreed or disagreed with different statements of how being physically active made them feel. The answer options were coded such that a higher number represented more agreement (i.e., 5 = "I agree a lot") and then correlated with the number of steps. As would be expected, the positive statements generally correlated positively with number of steps, and the negative statements correlated negatively with number of steps (see Table 6).

Table 6.

Correlation (and significance) between level of agreement with statements about how being physically active makes you feel and number of steps logged in the AHPC during the last two heats (fall 2009 and spring 2010). The statements are grouped by whether they reflect positive or negative attitudes and feelings towards being physically active, and then ordered by correlation magnitude (i.e., ignoring the sign of the correlation) and significant correlations are shaded.

Statement		*r*	Significance
Positive statements			
When I am physically active…	I enjoy it	.17	$p < .01$
	It's fun	.16	$p < .01$
	I find it satisfying	.13	$p < .05$
	I get something out of it	.10	--
	It feels good	.09	--
	It gives me a strong feeling of success	.07	--
	It's very exciting	.06	--
	It gives me energy	-.05	--
	My body feels good	.04	--
Negative statements			
When I am physically active…	I dislike it	-.20	$p < .001$
	It's not at all interesting	-.19	$p < .01$
	It frustrates me	-.16	$p < .05$
	I feel bored	-.14	$p < .05$
	It's no fun at all	-.11	--
	It makes me sad	-.11	--
	I'd rather be doing something else	-.09	--

Of the positive statements, three correlated significantly with number of steps: “I enjoy it”, “I find it satisfying”, and “it is fun”, indicating that as students agreed more with these statements they tended to log more steps. Of the negative statements, four correlated significantly with number of steps: “I feel bored”, “I dislike it”, “it frustrates me”, and “it is not at all interesting”, and in all cases more agreement with these statements tended to correspond to fewer steps logged during the two heats.

Summary

The findings of the surveys in each of the three heats paints a portrait of students as being generally very physically active and having a positive view of physical activity and a good self-image.

The students seem to have a positive view of physical education classes and the majority plays or practices some sports quite often a week. Their self-report indicates a very high general physical activity level and most consider themselves at least as or more active than their peers. The most commonly done physical activities over the three heats were walking, indoor chores, running, playing sports, playing outside and playing active games. On all three surveys the students reported overwhelmingly positive feelings towards being physically active and they generally seemed to have a good self-image and described themselves as being good at sports.

We found gender differences on many occasions; generally boys portrait themselves as more physically active than girls in that they both characterize their general activity level as higher than girls do, they report practicing sports more often, and they report doing strenuous and moderate exercises for at least 15 minutes more often during the week than girls do. Gender differences were also present in the type of physical activities the students reported doing, girls were more likely to dance, cheerlead, and do indoor chores, whereas boys were more likely to lift weights, do outdoor chores, skateboard, or play football, wii or DDR, or ball games.

Gender differences were also present in the attitudes and feelings towards being physically active. Girls rated physical activities, physical education classes, and how they felt when physically active more negatively than boys,

Due to issues with identifying students and retention of AHPC participants across the three heats we were not able to do a comprehensive longitudinal analysis throughout the three heats. Instead, we

opted to do two longitudinal analyses, the first phase spanned the first and second heat, and the second phase spanned the second and third. This allowed us to analyze longitudinal data for more participants.

The results of the longitudinal analyses did not yield any differences in terms of self-reported behavior; the students seemed to stay similarly active throughout the three heats. However, they did report a lessening enthusiasm for being physically active as time passed, but it is impossible to say whether this was due to the students losing interest in being physically active as they age, or because they lost interest in playing the AHPC and being physically active. In addition, the students reported physical education classes being more difficult in the spring 2010 as compared to the fall 2009, and as we did not find reports of less physical activity this is more likely due to the physical education classes becoming more difficult rather than the students becoming less able to handle physical activities.

We found a drop in family support for being physically active between the first and second heats, both in terms of family members joining the students in doing physical activities and encouraging them to be active. A possible reason for this is that the excitement about joining the AHPC in the beginning translated into more participation and encouragement from family members, but as the AHPC continued the "newness" and enthusiasm dropped off along with family involvement. The opposite pattern of results was found for the support of their teacher; the students reported more social support from teacher as the AHPC progressed. One reason for this could be that as the AHPC continued the teachers enthusiastic about the AHPC stayed in the program (as more schools dropped out of the Challenge with each heat), and this teacher involvement is represented by a general encouragement to the students to also keep participating.

The decreased enthusiasm for being physically active was also evident when the survey responses of the three heats were compared; specifically the students reported being more often too tired or too busy to exercise as the AHPC continued and they reported disliking physical activity more. This could be due to increased curriculum pressure with age, lessened enthusiasm for (and as a result less prioritization of) physical activities, or both. We did find however that more students reported getting something out of being physically active and that it gives them a strong feeling of success in the second heat as compared to the first one.

When we correlated the number of steps for the last two heats (fall 2009 and spring 2010) with survey questions about general physical activity level, we found that the frequency with which students say they do strenuous or moderate physical activities for at least 15 minutes per week did not significantly

correlate with number of steps. The frequency with which they said they did mild physical activities did correlate with number of steps, but in the opposite way to what would be expected: More frequently-done mild physical activities indicated fewer steps logged. However, how the students rated their general physical activity level had a moderate positive relationship with number of steps, indicating that as the students' self-reported activity level was higher they tended to log more steps, giving this question some potential predictive power.

The number of steps logged was also correlated with the frequency with which the students said they did specific physical activities. We found a significant positive relationship between steps and seven of the 32 activities: playing basketball, football, and soccer, biking, building, playing outdoors, and doing indoor chores. As these activities were done more frequently, more steps tended to be logged with the AHPC pedometers. It is not clear why these three sports (basketball, football, and soccer) correlate with steps but not other sports activities listed, but a possible reason could be that these sports are more popular in general and/or are very conducive to accumulating steps (pedometers can be worn and the sports involve a lot of running).

At first blush it was surprising to us that walking and running did not correlate significantly with number of steps, but a possible reason is that these are activities that all students do regularly and frequently (in both cases about 80% of students do these activities at least weekly or more often), and therefore no relationship emerges between the frequency of doing these activities and the number of steps; that is, these activities already contributed to the baseline number of steps for most students and were not affected by the AHPC intervention.

We also found a relationship between number of steps and the frequency with which the students practiced or played on a sports team, such that more practice or play on a sports team predicted a higher number of steps logged. We found though that this relationship was mostly determined not by the frequency of practicing or playing with a sports team (e.g., whether or not the students did so almost daily or a few times a week) but whether or not they were on a sports team. When the students who said they were not on a sports team were excluded from the analysis, the relationship disappeared.

When ratings of agreement with statements describing attitudes and feelings towards being physically active were correlated with number of steps, we found that generally agreement with positive statements correlated positively with number of steps and agreement with negative statements correlated negatively with number of steps. The positive statements with significant correlations with

number of steps all emphasized intrinsic enjoyment of being physically active (enjoy it, find it satisfying and fun), whereas the negative statements emphasize intrinsic dislike of being physically active (bored, frustrated, dislike it, not interesting).

Parent Survey Results

The data presented in this section were gathered with two surveys sent to the parents of the students participating in the AHPC in the spring 2009 heat and the fall 2009 heat. The detailed data analysis of the first survey was provided in an earlier report and therefore these data are used only for comparison and will be summarized here. Unless otherwise stated the data discussed in the following sections are based on to the parent survey sent out in the fall of 2009.

First, we report on the physical activities of the parents and their children as reported by the parents, then we compare responses from the parent and student surveys, discuss characteristics of the home neighborhood, and finally report findings on the support the family provides the students in being physically active.

When discussing support for being physically active that the participants in the AHPC received from their families, we not only included results from the parent surveys but also highlighted main findings from the student surveys on this topic to try to get a fuller picture of family support.

In the spring 2009, 279 parent surveys were returned, representing parents of children from 20 different schools (see Table 1). In the fall 2009, 202 parent surveys were returned, representing parents of children from 13 schools. Of returned fall surveys 98.5% were filled out by parents, 1% was filled out by grandparents and 0.5% was filled out by some other family member (aunt).

Table 1.

Number of parents that answered surveys in the fall 2009 by school.

School	Nr of surveys spring 2009	% of total (N = 279)	Nr of surveys fall 2009	% of total (N = 202)
School 4	20	7%	12	6%
School 6	18	6%	12	6%
School 9	--		10	5%
School 10	--		34	17%
School 12	18	6%	--	
School 14	--		14	7%
School 16	6	2%	--	
School 20	13	5%	--	
School 24	--		13	6%
School 25	15	5%	8	4%
School 28	16	6%	11	5%
School 35	15	5%	28	14%
School 37	11	4%	--	
School 38	7	3%	19	9%
School 50	20	7%	20	10%
School 52	14	5%	--	
School 54	4	1%	--	
School 56	36	13%	--	
School 58	13	5%	--	
School 60	19	7%	9	4%
School 66	7	3%	12	6%
School 70	8	3%	--	
School 73	16	6%	--	
School 76	3	1%	--	

Physical Activities

PARENT PHYSICAL ACTIVITIES

The parents were asked about their own general physical activity level, and half of them characterized their activity level as medium on most days, whereas 25% said their general activity level is either very low or low, and 25% said it is high or very high (see Figure 1). In the spring 2009, the parents were asked the same question and the data looked very similar: About half of the parents described their own activity level as medium, 24% described it as being either high or very high, and 20% described it as low or very low. There was no difference in the parent's rating of his or her own activity level on the two survey occasions ($p > .05$).

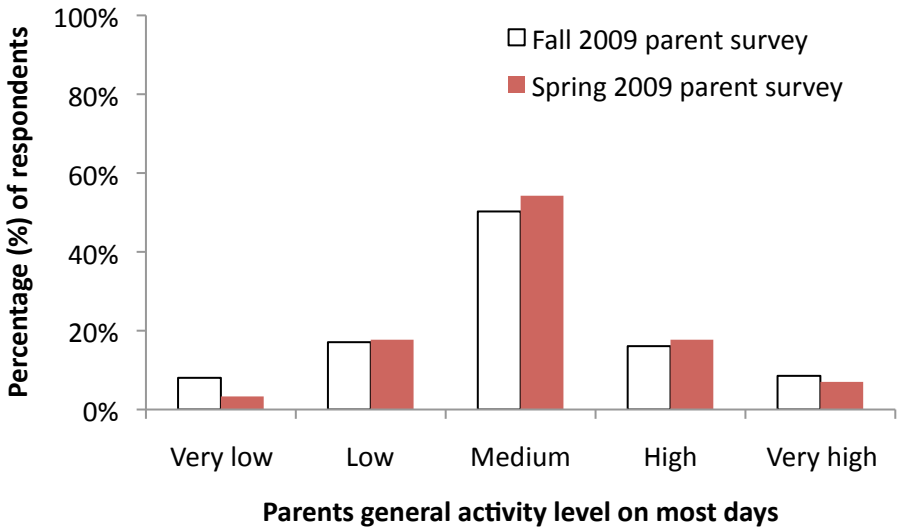

Figure 1. Percentage of parent respondents rating their general physical activity level on most days as very low, low, medium, high, or very high in the spring and fall 2009 surveys.

When asked to rate how their physical activity level compared to other people their age, 26% said it is generally higher than other people their age, 54% said it is about the same (neither higher nor lower), and 21% said it is generally lower than of their peers. This reflects a similar distribution as seen in the results on their rating of their general activity level on most days.

To have a better way of quantifying their general activity level, the parents were asked how often a week they engaged in strenuous, moderate, or mild exercises for at least 15 minutes. The question however seemed to puzzle many respondents and only about half of the survey respondents gave answers that could be compared. This misunderstanding of the question was unexpected, as it had earlier been used successfully in the student survey. A likely reason was that the student survey was computerized whereas the parent survey was paper based. The students therefore could choose options

from a dropdown box but the parents had to write a number. This open-ended method of collecting responses for this question therefore seems ill advised in hindsight.

Roughly one-third of the respondents who answered the questions never did any strenuous exercises, 32% did so 1-2 times a week, and 34% engaged in strenuous exercise 3-7 times a week (see Figure 2). The numbers for the moderate and mild exercises were similar: About fifth of the respondents never did any moderate or mild exercise, 23-26% did so 1-2 times a week, and 53-54% said they did moderate or mild exercises 3-7 times a week. Therefore, respondents tended to do less strenuous exercise more often in the course of a week.

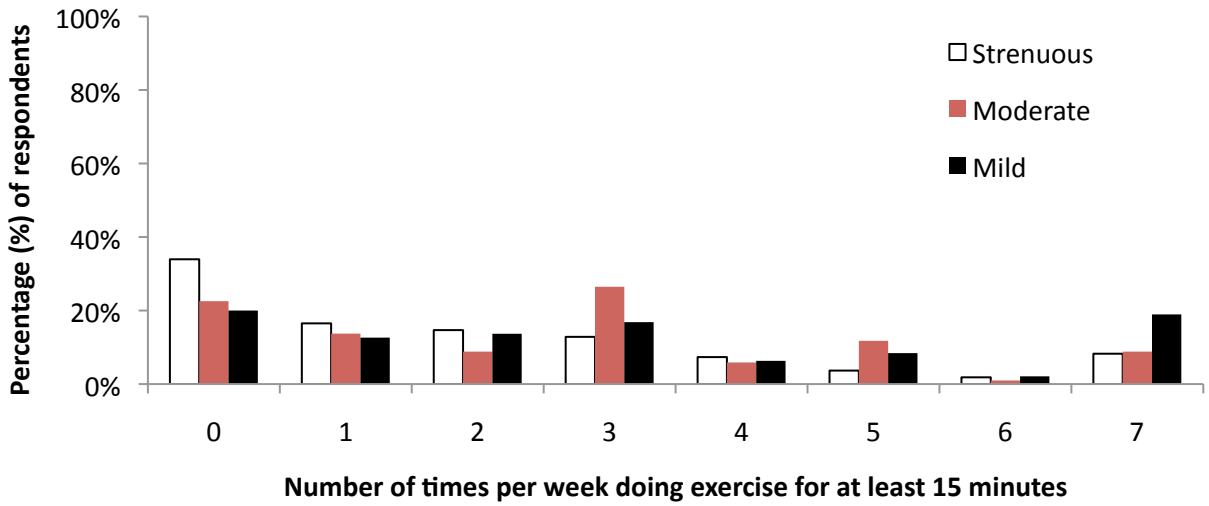

Figure 2. Percentage of parent respondents who do strenuous, moderate, or mild exercise for a given number of times per week.

CHILD'S ACTIVITIES ACCORDING TO PARENTS

The parents were asked to rate their child's activity level on most days, and half rated it as high or very high, 43% rated it as medium, and only 8% rated it as low or very low (see Figure 3). In the spring 2009, the parents were asked the same question and the answers were very similar: 60% of them rated their children's general activity level as high or very high, 33% described it as medium, and only 7% described it as either low or very low. There was not a significant difference between the ratings of the children's general activity level on the two survey occasions ($p > .05$).

When asked how their child's activity level compared to kids their own age, 35% of parents said it was generally higher, 58% say it was about the same, and 7% that it was lower. When compared to how the

parents described their own physical activity level, this indicates that generally they believed their children to be more active than themselves.

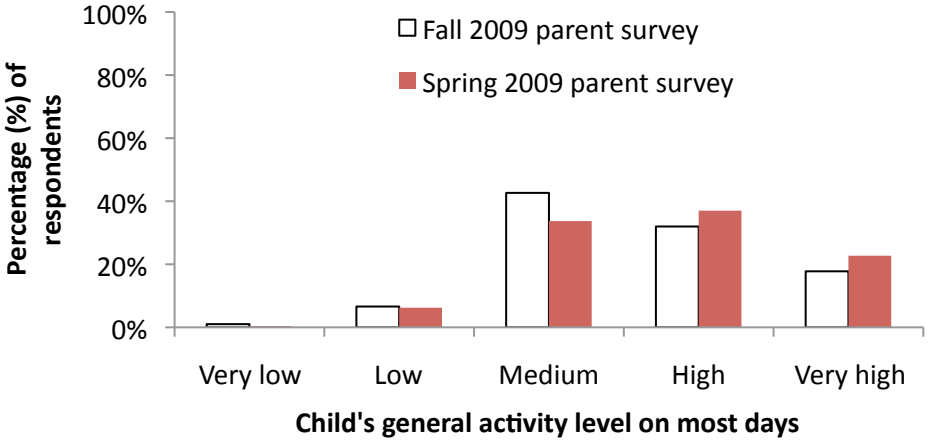

Figure 3. Percentage of parent respondents rating their child's general physical activity level on most days as very low, low, medium, high or very high on the spring and fall 2009 surveys.

The parents were asked to rate how often their children did strenuous, moderate, and mild exercises per week. Only about half of the respondents provided usable answers. About one-fifth of the respondents who answered the question estimated that their child never does strenuous exercise, 28% said they do strenuous exercises 1-3 times a week, and 42% said they do strenuous exercises 3-7 times a week (see Figure 4). The results were similar for moderate and mild exercises: 9-14% of respondents said their child never does these types of exercises, 22-24% said they do so 1-3 times a week, and 64-67% said their child does moderate and mild exercises 3-7 times a week.

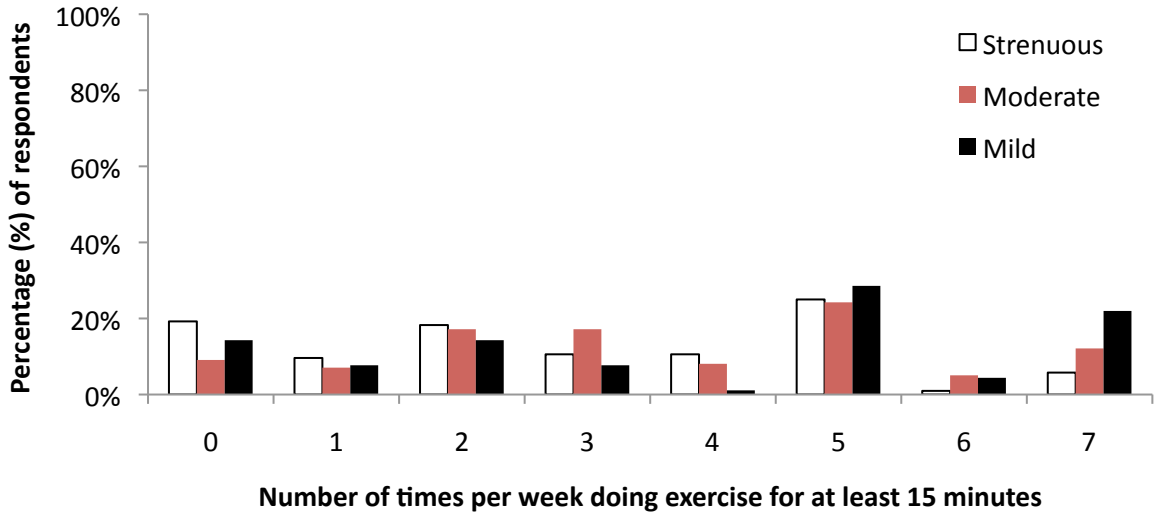

Figure 4. Percentage of children who do strenuous, moderate, or mild exercise for a given number of times per week according to their parents.

The parents were asked how much time their child spends on different sedentary activities on a typical weekday. According to the parents their children spent most time watching TV, DVD's, or video, hanging out or talking with friends and family, and doing homework (11-22% said their kids spend more than 3 hours doing these activities on a typical weekday; see Table 2). The activities the children spent the least amount of time on during a typical weekday were sitting talking on the phone or texting and doing inactive hobbies (32-33% said their kids never do these activities).

Table 2.

Time children spent on different sedentary activities on a typical weekday according to their parents. The activities are ordered from the ones most frequently done to the ones least frequently done. The time the largest percentages of children spend on an activity is highlighted.

Activity	Never does this	Less than 1 hour	1-2 hours	3-4 hours	5 hours or more
Watching TV, DVD's or videos	0%	26%	52%	15%	7%
Hanging out/talking with friends or family	3%	40%	36%	13%	9%
Doing homework	3%	42%	45%	9%	2%
Playing non-active computer/video games	14%	49%	28%	7%	2%
Reading books or magazines (not for school)	17%	53%	24%	4%	1%
Using the Internet	18%	54%	21%	6%	1%
Riding in a car	19%	60%	15%	4%	2%
Sitting listening to music	20%	47%	22%	9%	2%
Doing inactive hobbies	32%	42%	19%	3%	4%
Sitting talking on the phone or texting	36%	45%	13%	4%	2%

The parents were asked to rate how frequently they do listed activities with their children. The most frequently done activities were indoor chores and walking, with 77% and 51% of the parents doing those respective activities with their children weekly or more often (see Table 3). Other activities that the parents frequently did with their children were outdoor chores, running, exercise, and walking the dog. The activities that the parents most rarely said they did with their children were playing with a marching band, cheerleading, yoga, hockey, horseback riding, and practicing combative sports.

In the parent survey in the spring 2009 this question was not as detailed and the parents were asked to circle activities in a list they did with their child at least once a week. Unlike the activities listed in the fall 2009 survey, this list also included low intensity activities (such as watching TV, reading, talking, and shopping), but these were omitted to shorten the survey in the fall. The most commonly circled activities (selected by more than two thirds of the parents) were going shopping, visiting friends or family, cleaning up the house, talking in person, and watching TV or DVD. The activities listed in the spring 2009 survey that corresponded to activities used in the fall 2009 survey are included in Table 3 for comparison.

It is interesting to note that on both survey occasions (spring and fall 2009) doing indoor chores was the activity the parents were most likely to do with their children at least weekly.

Table 3.

Frequency with which the parents do the listed activities with their children. The activities are ordered from the ones most frequently done to the ones least frequently done.

Activity	At least daily	At least weekly	Weekly (spring 2009)	At least monthly	A few times a year	Never
Indoor chores	27%	50%	84%	13%	5%	5%
Walking	29%	22%	56%	17%	24%	8%
Outdoor chores	7%	26%		31%	19%	18%
Running	19%	15%		10%	21%	35%
Exercises	11%	18%		13%	23%	35%
Walking the dog	13%	15%	23%	13%	12%	46%
Outdoor play	12%	15%	44%	19%	29%	25%
Basketball	8%	17%		14%	30%	33%
Playing Wii or DDR	10%	15%		18%	22%	36%
Active games	10%	13%		19%	29%	29%
Playing in water	7%	10%		14%	54%	15%
Bicycling	7%	11%		15%	35%	32%
Other ball games	7%	11%		13%	32%	36%
Baseball / Softball	6%	14%		14%	21%	45%
Football	7%	15%		10%	21%	47%
Dance	8%	14%	20%	13%	18%	48%
Soccer	9%	12%		7%	20%	53%

Skateboarding / Scooter	9%	13%		8%	13%	57%
Building things	5%	6%	8%	14%	29%	46%
Camping	1%	2%	18%*	8%	42%	47%
Swimming laps	6%	6%	24%**	10%	32%	47%
Hiking	6%	5%	18%*	12%	28%	49%
Fishing	1%	2%	18%*	13%	35%	49%
Skating	3%	5%		7%	31%	54%
Racquet sports	1%	5%		8%	23%	64%
Weight lifting	5%	6%		4%	11%	75%
Gymnastics	3%	5%		5%	10%	78%
Combatives	3%	6%		4%	8%	80%
Horseback riding	1%	3%		3%	12%	81%
Hockey	1%	5%		3%	8%	84%
Yoga	1%	2%	2%	5%	6%	87%
Cheerleading	4%	4%		2%	2%	89%
Marching band	2%	2%		4%	1%	91%

* In the spring survey camping, fishing, and hiking were listed as one activity

** In the spring survey, this was called swimming at the pool or the beach

The results of the spring 2009 parent survey indicated that parents tended to engage in low intensity activities rather than high intensity activities (such as playing sports, playing outside, walking the dog, and swimming) with their children at least once a week.

Comparison of Student and Parent Surveys

In the surveys sent out to the parents of the AHPC student participants both in the spring and fall 2009, the parents were asked to rate their child's general activity level on the scale "very low", "low", "medium", "high", and "very high".

On both occasions, the parents rated their child's general activity level on average high and we found no difference for ratings on the two survey occasions. To get a sense of how accurate these ratings were we compared them to the number of steps the students logged with the pedometer. In the spring 2009 heat, we could link 90% of the parent surveys to a specific student, but in the fall 2009 heat, only 31% of parent surveys could be linked to a student.

When the parents' descriptions were compared with the number of steps the students logged during the spring 2009 heat, we found a general agreement between the parents' ratings and the step count (see Figure 39). Children categorized by their parents with higher general activity level tended to log more steps on average than children categorized with lower general activity level.

When the parents' descriptions were compared with the number of steps the students logged in the fall 2009 heat, a similar pattern emerges. There are a few exceptions though; first, the students categorized as having low physical activity level by their parents actually accumulated more steps on average than the students categorized as having medium activity level (see Figure 5). Second, no parent in the fall 2009 survey categorized their child as having very low physical activity level, and third it is noteworthy that the increase in number of steps between the last categories (medium, high, and very high) is higher in the fall 2009 than was seen in the spring.

On both survey occasions, the general step pattern seems to mirror the parent's rating of general activity level. It would therefore seem that the parents have a general idea of how active their children are; at least when the pedometer data is used for reference and the activity level description is quite broad.

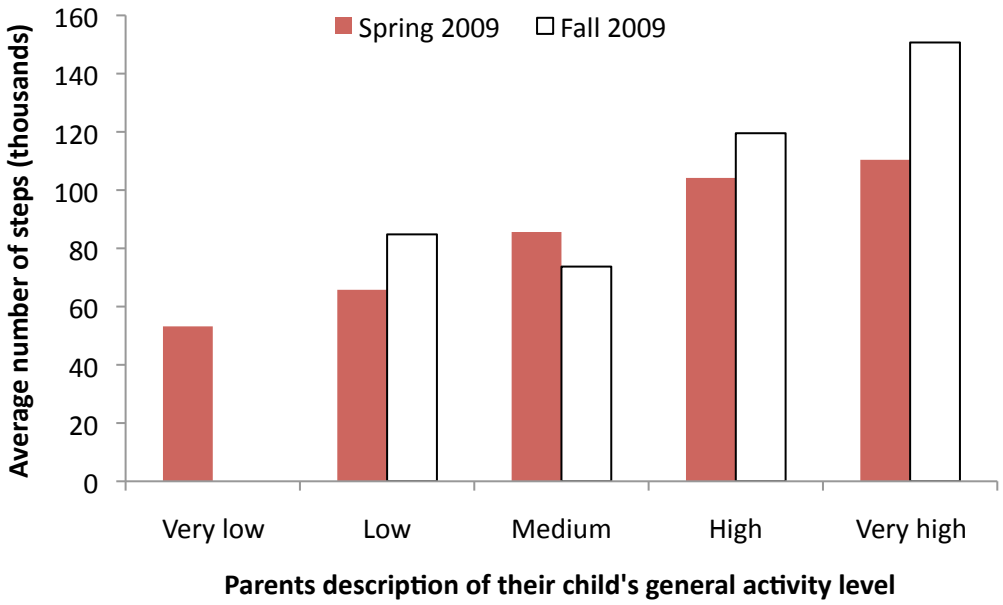

Figure 5. Average number of steps taken by the students categorized by parent's description of activity level for both spring and fall 2009.

Home Neighborhood

The questions about home neighborhood in the parent surveys were aimed at understanding where the students participating in the AHPC are physically active and what their opportunities are for being physically active in the neighborhood where they live.

The parents were asked where their children are active and how frequently. The places most frequently used for activities were playing fields or courts (66% used at least every other week), friend or relative's house (69% used at least every other week), and walking or running tracks (53% used at least every other week; see Table 4). The least frequented places were YMCA centers (91% never used), beach, lake, river, or creek (40% never used), and large public parks (39% never used).

Table 4.

Places where the children are active according to their parents and the frequency with which they are active there. The places are ordered from the ones most frequently used to the least frequently used.

Place where child is active	Never	Once a month or less	Once every other week	Once a week or more
Playing fields or courts	16%	17%	13%	53%
Friend's or relative's house	3%	29%	30%	39%
Walking / running track	22%	22%	18%	35%
Indoor recreation / exercise facility	33%	25%	8%	35%
Bike/hiking/walking trails or paths	20%	31%	21%	28%
Public open space (not a park)	33%	29%	16%	22%
Swimming pool	28%	45%	10%	17%
School with recreational facilities (open to public)	46%	26%	10%	17%
Small public park	25%	39%	22%	14%
Shopping mall / plaza	15%	50%	23%	13%
Large public park	39%	38%	12%	10%
Beach, lake, river, or creek	40%	47%	8%	4%
YMCA	91%	5%	2%	3%

The parents were then asked how their children travel to these places, and on average most children either get a ride (39%) or walk (23%; see Table 5).

For most places, children received rides from adults, particularly to malls or other people's houses. The places the children most often walked to were friends and relatives houses, as well as recreational facilities such as tracks for walking or running, small public parks, playing fields or courts, non-park public spaces.

On average, only 7% of the children biked and 4% used public transportation. The most common places the children biked were recreational trails or paths (25%). The most common reason for using public transportation was to travel to and from school (30%).

Table 5.

How the children travel to various places according to their parents. The most frequently used method of transportation for each place is highlighted.

Place	Walks	Bikes	Uses public transport	Gets a ride	Not applicable
School	22%	3%	30%	44%	2%
Indoor recreation or exercise facility	16%	6%	2%	44%	32%
Beach, lake, river, or creek	6%	4%	2%	48%	41%
Bike/hike/walking trails or paths	25%	25%	2%	24%	25%
Playing fields or courts	31%	6%	2%	42%	20%
YMCA	5%	1%	1%	11%	83%
Swimming pool	21%	6%	1%	42%	29%
Walking/running track	46%	3%	2%	23%	26%
School with recreational facilities (open to public)	20%	4%	6%	32%	39%
Small public park	40%	10%	0%	31%	20%
Large public park	18%	8%	2%	41%	31%
Public open space (not a park)	33%	10%	0%	23%	34%
Shopping mall or plaza	4%	1%	4%	79%	14%
Friend's or relative's house	30%	6%	1%	60%	3%

When asked what kind of area they live in, respondents were equally distributed among rural, small town, suburban, and city neighborhoods areas (around 20% in each type of area), with only 4% living in an inner city neighborhood (see Figure 6).

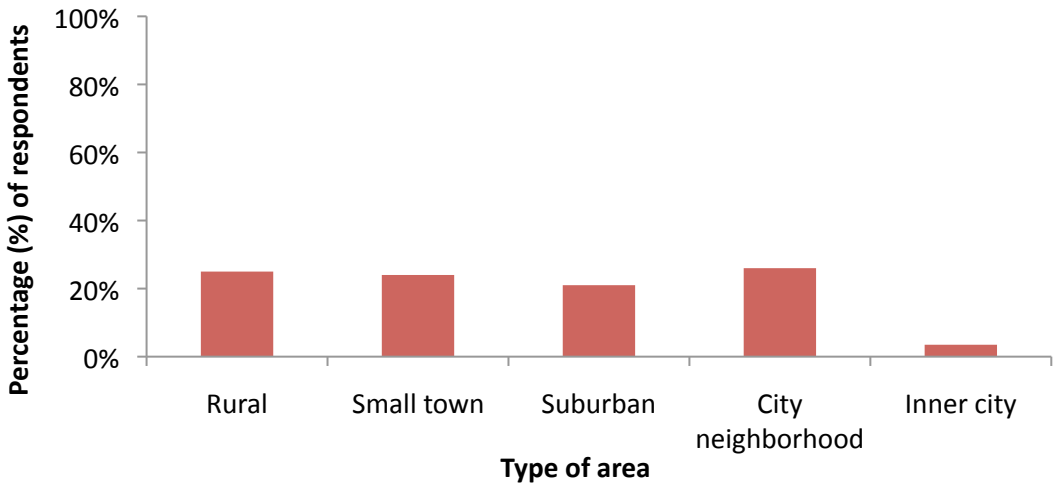

Figure 6. Type of area the respondents live in.

In both parent surveys, the parents were asked to rate their agreement with statements describing their neighborhood (see Table 6 for a list of these statements). In each case they were asked to select whether they strongly disagreed, disagreed, neither disagreed nor agreed, agreed, or strongly agreed with the statement. To provide an overview of the general agreement with the statements, the answer options were coded from 1 to 5 (1 = strongly disagreed and 5 = strongly agreed) and then averaged across all the respondents (a higher scores therefore indicates a more agreement with statement). The results for both survey occasions are depicted in Figure 7.

Table 6.

Statements about home neighborhood with which the parents were asked to rate their agreement.

Statements
There are many interesting places for my family to visit (such as stores, playgrounds, libraries, or community centers) within easy walking distance of my home
There are many hillsides, bodies of water, dead-end streets, or other things where I live that limit the number of routes from place to place
It is easy to get around on foot where I live
There are many interesting things to look at while walking where I live
I see and speak to other people when I am walking in the area where I live
There is so much traffic along nearby streets that it makes it difficult or unpleasant to walk in the area where I live
The speed of traffic on the streets where I live is usually slow (30 mph or less)
I feel safe to let my children play and walk around in the area where I live

Note that the statement "It is easy to get around on foot where I live" was added in the fall 2009 survey and therefore does not have a corresponding statement in the spring 2009 survey. Also, the statement "There are many hillsides, bodies of water, dead-end streets…" in the fall 2009 survey was combined from two different statements in the spring 2009 survey and the average of the agreement to those two statements is used for comparison in Figure 7.

Generally, the parents who answered the survey on the two different occasions had a similar level of agreement with these statements (no significant difference between survey occasions was found, $p > .05$ for all statements). Therefore, the home neighborhood for the two parent samples seem to be rated similar as to how much opportunity it provides for physical activities around the neighborhood.

There was a good agreement with statements describing the neighborhood as safe for children and good for walking, and the respondents tended to disagree with statements describing the neighborhood as difficult to walk in and with limited routes.

The only statement that resulted in rather different ratings was whether there are interesting places within walking distance; in the spring 2009 survey the parents tended to disagree with this statement, but in the fall 2009 survey the parents equally disagreed and agreed with the statement.

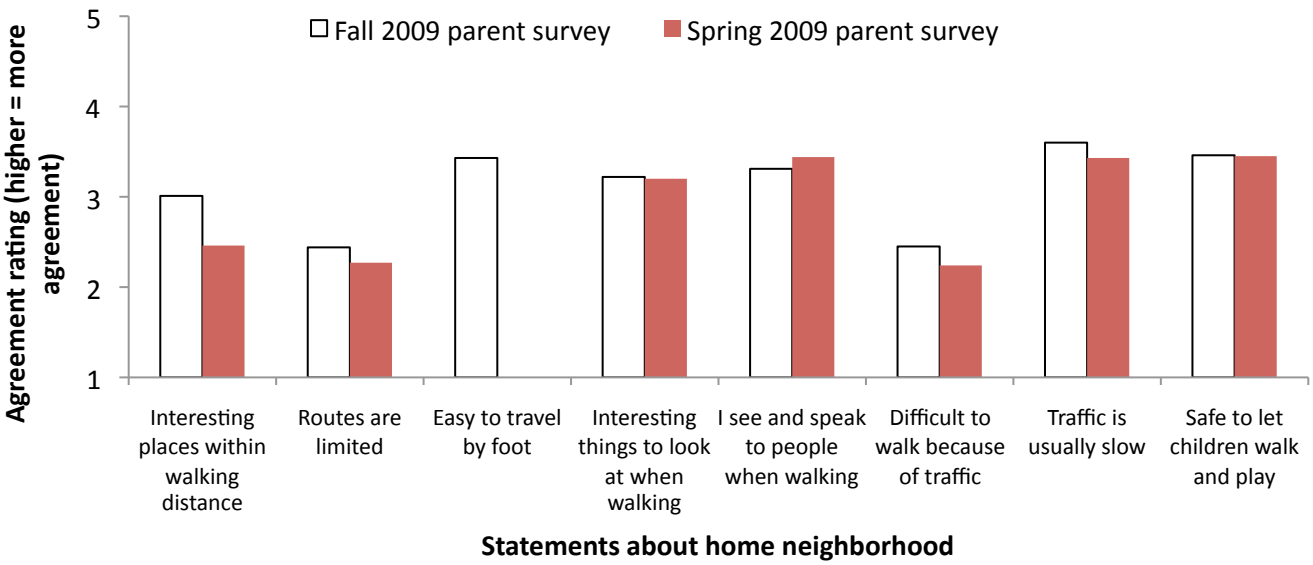

Figure 7. Average parent agreement on both survey occasions (spring and fall 2009) with statements about their home neighborhood. A higher rating means more agreement as 1 was used to represent "strongly disagree" and 5 to represent "strongly agree".

Family Support

The parents were asked how often in the past week they had encouraged their child to be physically active or play sports, participated in a physical or sports activity with the child, or transported the child to a place to be physically active or play sports (see Figure 8). The majority of parents (84%) said they had encouraged their child to be physically active or play sports at least a few times in the past week. However, fewer parents (60%) had done any physical activity or played sports with their child at least few times in the past week. About two thirds of parents (62%) had transported their child to a place where he or she could do physical activity or play sports in the past week.

Overall, the parents seem to support their children in being physically active or play sports, as they generally encourage them, do activities with them, and help the children get to places where they can be active or play sports.

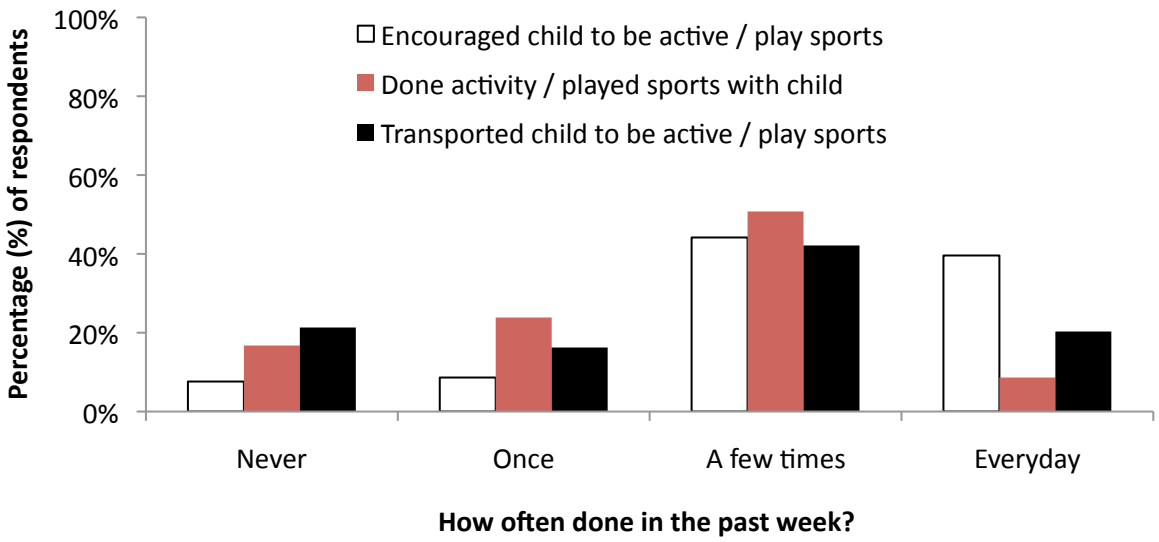

Figure 8. Percentage of parents who say they encouraged child to be active or play sports in the past week, did activity or played sport with child in the past week, and transported child to be active or play sports in the past week.

When asked whether they had paid fees so their child could take lessons in physical activities, about half (49%) said they had, and likewise about half (49%) said they had paid fees so that their child could participate in organized physical activities or a sports team. The majority of parents (74%) said they do not have a family membership to a health club, gym, or a pool.

When the students participating in the AHPC in the spring 2009 were asked who joins them for physical activity, 45% said their parents do, 30% that other adults in the family do, and 69% said that other kids in their family join them for physical activities. However, when asked who encourages them to be physically active, 80% of students said their parents did, 50% said other adults in family, and 57% said kids in family. Therefore, parents seemed to choose rather to encourage their children to be physically active than to actually be physically active with them.

In the fall 2009 and spring 2010 student surveys, the AHPC participants were asked about the social support their families provided in helping them being physically active. To get an overview of the social support, the statements were grouped into four categories: 1) whether the families participated in physical activities, 2) whether the families encouraged the students to be physically active, 3) whether the families discussed exercise with the students, and 4) whether the families had any criticism or complaints about the students exercising. For each category, the frequency of support was averaged,

such that a lower number represents less family support in that category and higher means more support. The results are depicted in Figure 9, and show that on average the students said they did not get very frequent social support from their families in being physically active, as the averages for the first three categories hover between two and three, which represent “rarely” and “a few times”. Even though the social support was not very frequent, it was still present, and the results for the fourth category showed that the students were not being criticized for being physically active, and their families did not complain about the time they devoted to being physically active.

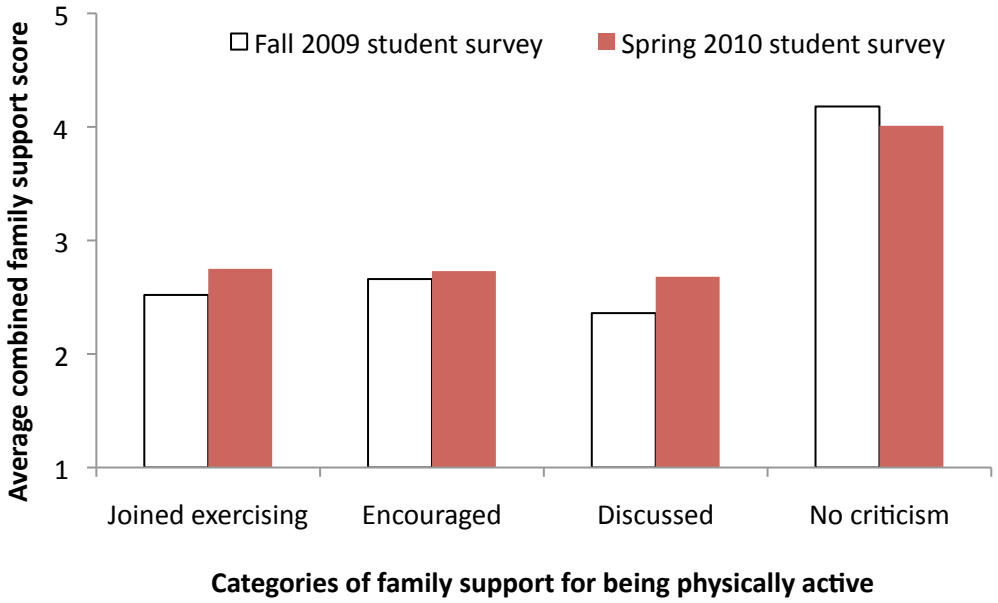

Figure 9. Average family support for being physically active according to the student participants divided into four categories: whether family joined them in being physically active, encouraged them to be physically active, discussed physical activities with them, or complained about them being physically active. A higher score indicates more support, for example, the very high score for the complained category indicates that students overwhelmingly agree that no criticism was more frequent than criticism and complaints.

Summary

When asked about their own general physical activity level about half the parents said it was medium and about the same as their peers, whereas about fourth said their physical activity level was low or very low and less than of their peers. About third never did any strenuous exercise, and about 20% said they never did moderate or mild exercise. Therefore, it seemed that of the parents answering the survey

in the second heat, about one-fifth of them were generally inactive and did not engage in much physical activities.

Most parents characterized their children's general activity level as high or very high and said their children engaged in strenuous or moderate exercise five times a week or more. However, about 20% still said their children never did strenuous exercise in the course of a week. From comparing the children's number of steps in the AHPC to the parent's description of their general activity level, it would seem that the parents had a good general sense of how active their children were.

According to the parents, the children spent about three hours each weekday watching TV or videos, hanging out and talking with friends and family, and doing homework. It could therefore be concluded that the children were more likely to be active away from the home on weekdays (at school for example) as the most time consuming weekday activities the parents said the kids did at home were fairly inactive.

When asked which activities the parents frequently did with their children, doing indoor chores and walking were the most commonly mentioned, but outdoor chores--running, exercising, and walking the dog--were also frequently listed. On both parent surveys (in the spring and fall 2009), doing indoor chores was the activity the parents were most likely to do with their children at least weekly.

About an equal number of parents who returned the surveys in the fall 2009 reside in rural area, small town, suburban, and city neighborhoods. This however did not seem to affect how safe they considered the neighborhood for their children or how accessible for walking.

According to the parents, the places where their children were active most frequently were playing fields or courts, friends or relative's house, and walking or running tracks. The least frequented places for activities were YMCA centers, places with water access (e.g., beach, lake, river, or creek), or large public parks. One can surmise that the most frequented places are easily accessible within the community or neighborhood where they live and even places where parents allow their children to go on their own, whereas the less frequented places are not. This conclusion is supported by the fact that the more frequented places are also the places the children are more likely to walk.

Most children seemed to either get a ride or walk to the places they need to go. The places the children most often walked to were tracks for walking or running, small public parks, playing fields or courts,

other public places, and friends or relatives house. However, overall it was more common for the children to get a ride to where the need to go, and only a small proportion bike or use public transport.

When it comes to supporting the children in being physically active, most parents seemed to be supportive, specifically by encouraging them to be physically active or play sports, transporting them to places where they can be physically active, or by joining them for physical activities. It was however more common for the parents to be verbally supportive than to actually do physical activities or play sports with their children. About half of the parents had paid for their children to take lessons relating to physical activities or so they could participate in organized physical activities or play sports. Given these results, it is curious that the students did not report that they get very frequent support from their families in being physically active. One reason could be that the perception of support differs for the children and their parents, as the children might be comparing their parents' show of support to that of other adults who encourage them to be active, such as teachers or coaches, whereas the parents do not have that kind of comparison.

The AHPC Student Experience

In this section we discuss the experience of the students participating in the AHPC, and look at data gathered through surveys and site visits. First, we present the findings of a survey we asked students to complete during the third heat, which asked about their experience with playing the AHPC. Second, we discuss findings relating to the social aspects of participating in the AHPC, such as peer and teacher support, and finally we provide an analysis of motivators for participating in the AHPC.

The AHPC Survey Results

We sent out a survey in February 2010 to collect students' feedback on the AHPC, and received 186 answers from 23 schools. The majority of respondents were 12-13 years old and a little over half were female. The analysis was divided into five categories: Attitudes towards the AHPC, performance and behavior during the AHPC, social aspects of participating in the AHPC, motivation for participating in the AHPC, and user interface feedback. These data have been presented before in detail and therefore we provide only the highlights of the results here.

ATTITUDES TOWARDS THE AHPC

The respondents who had participated in other pedometer based programs generally viewed the AHPC favorably in comparison to those programs. Only 2% of respondents considered the AHPC to be worse than other pedometer based programs. There was no difference between genders on whether they thought the AHPC to be better, worse, or about the same as other pedometer based programs ($p > .05$). In comparison, the teachers had less positive evaluation of the AHPC than the students. Three out of eight teachers (38%) rated the AHPC to be similar to other programs, while four (50%) thought that the AHPC was better. Of the students who participated in other programs 17% rated the AHPC to be about the same as other pedometer based programs and 79% considered it to be better. The difference between the teachers' perception and the students' attitudes towards the AHPC showed that the Challenge provided different experience to the teachers and the students. In current design of the Challenge, the teachers were involved as faciliators, but the students as players. This finding indicates that there might be design opportunities to incorperate teachers as more engaged participants, but it

has to noted that these results are based on responses from very few teachers and should therefore be interpreted with caution.

We also asked the students to rate the AHPC, physical education class, and physical activities that make them sweat on four different dimensions. Table shows the comparision between these three actiities. The ratings on the four dimensions (“awful-awesome”, “frustrating-relaxing”, “boring-fun”, “difficult-easy” were generally positive for all three activities. Compared to the organized physical education classes, the AHPC was rated as slightly less awesome, relaxing and fun, but easier. While compared to physical activities that make them tired or sweat, the students rated the AHPC as more awesome, relaxing, fun, and easier (see Table 1).

Table 1.

Ratings of AHPC, physical education class, and physical activities that make the students tired or sweat on four different dimensions.

Dimension	AHPC	Physical education class	Physical activities that make me tired or sweat
Awful-Awesome	4.2	4.3	3.8
Frustrating-Relaxing	3.8	3.9	3.5
Boring-Fun	4.2	4.4	4.2
Difficult-Easy.	4.3	4.1	3.6

There were no differences found between the genders on how they rated the AHPC on these four dimensions.

When considered overall, the respondents had a positive view of the AHPC. This conclusion is consistent with the results that only 3% of respondents said they got bored with the AHPC, and only 4% said they got frustrated with their school’s progress in the Challenge.

Website usage

We surveyed students about how frequently they used specific functions on the AHPC website and how easy they found learning how to use the website.

The most common activities the respondents did when using to the AHPC system and website was uploading steps, logging in, checking how well their school was doing, and buying items for their horse. This indicates which activities the student participants saw as priorities in the AHPC and affirms the assumption that checking steps and modifying the horse avatar were motivating activities. However, it is interesting to note that about one-fourth of respondents logged into the AHPC website or modified their horse less than once a week.

The features of the AHPC website that the respondents most frequently said that they never used were checking out horses belonging to participants at other schools, writing status messages for the horses, checking out or changing their own and other school's buses, and checking out information about the racetracks. The first three functions were related to the social interaction among the participants within their schools. During the focus groups and individual interviews, some students expressed a wish for a real time chat and better visibility of other players' status, showing their interest in within game interactions. The current design did not address these requirements very well. The last function mentioned above was related to the educational goal of the game, as the students were expected to learn about the places visited in the game. In addition, we found in the student interviews, that some students misunderstood the purpose or goal of the tracks (i.e., one student mentioned that she thought these tracks represented kids from other countries that also played the AHPC). In the current design, the reason for the different tracks and the jump between tracks was not explained, making it difficult for the students to comprehend what was going on.

Most students figured out how to use the website by themselves, but more than half said that their teacher helped them use the website. The majority said that they found it easy to figure out how many steps they had or their school. Most also agreed that it was easy to modify their horse and that there were enough options for doing this. Just over half also knew how to check out other kids' horses and knew what the horses of their classmates looked like. It is noteworthy though that about one-third of the students did not know how to check out other kids' horses.

Pedometer usage

When asked about the pedometer, one-third of respondents did not believe that the pedometer accurately collected their steps. This indicates a rather high level of distrust, but corresponds with the fact that 58% of the entries in the step database were missing data towards the end of the game. Interestingly, more than half of the respondents agreed that it was easy to get steps without doing real

physical activities, but at the same time, the majority of respondents believed the AHPC to be a fair competition.

Nearly all the students said that they wore their pedometer always or most of the time on weekdays, and the majority wore their pedometer always or most of the time on weekends too. A third of the respondents lost their pedometer in the course of the AHPC, but most found it again or got a replacement. Of the respondents who practiced on a sports team, about two-thirds wore their pedometer always or most of the time while practicing. These findings indicate that generally, the students answering this survey actively participated in the AHPC and this sample of students might therefore represent generally more engaged students.

PERFORMANCE AND BEHAVIOR DURING THE AHPC

The performance level of the students was objectively recorded in the step log database. In the survey, we focused on investigating the participants' subjective self-evaluation of performance in the Challenge. When asked to compare their performance in the AHPC with other participants in their school and other participating schools, about two-thirds of respondents believed that they personally, and their school, performed better. There was no difference between the genders in how they viewed their own performance or school performance in comparison to others. It is notable that no respondents believed that they had personally performed worse than their peers had and only 8% believed that their school had done worse than other schools in the AHPC. These results suggest that students felt pride associated with participating in the AHPC. This indicates that both challenge level and perceived performance level should be taken into account when designing challenge-based interactive systems for this specific age group.

Respondents were asked to indicate whether they believed statements describing behavior and change in behavior during the AHPC applied to them (e.g., "I tried a new sport" and "I ate more healthy foods than I did before the program"). Generally, respondents indicated some change in behavior and only 3% stated that they did not change anything during their participation in the AHPC. About one-third of the respondents said that they walked more than they did before the AHPC and that they found new ways to get steps. For instance, one-fourth said that they tapped their feet during class and a fifth of the respondents said they ate healthier food and tried a new sport during AHPC participation.

We also asked questions about how the participants got steps. About two thirds of the students stated that they set goals for themselves at least once a week (in terms of number of steps they wanted to reach), whereas 47% stated that the teacher set goals for them. The students also reported trying new things to get more steps, and the following activities were the most frequently mentioned: "I tried something I'd never done before to get steps " (25%), "I tapped my feet during class" (25%), "I ate more healthy foods than I did before the program"(20%), and "I tried a new sport"(20%). During the site visits, we heard numerous stories of how he students found new ways to get steps, such as walking with parents to a nearby grocery store (after persuading the parents to do so), jogging with parents in the morning, joining the dance club and track team, and walking the dogs more often. Although some of the activities might be harder to sustain after the Challenge ended, the statistics from the survey and examples from the interview indicated that the students were able to rethink their daily activities into ways of getting steps, even though many of these had not been thought of as exercise before.

Social Aspects of Participating in the AHPC

Most participants discussed the AHPC with their parents and the majority discussed the Challenge with their teachers. It is notable that one-fourth of the respondents said that they never discussed the AHPC with their teacher although qualitative data indicated that the involvement of teachers was an important element of the Challenge. Half of the respondents regularly discussed the AHPC with other students participating in the Challenge, but they generally did not discuss the Challenge with non-participating students in their school.

The majority of respondents agreed that the kids participating in the Challenge worked as a team, that their teacher organized activities to increase number of steps, that they themselves motivated others to be more active, and that they did more physical activities with peers than before the Challenge. In addition, almost half said that they did more physical activities with their families than before the Challenge. All this indicates that the AHPC successfully encouraged the participants to become more physically active and helped create an atmosphere of social support and encouragement. No difference was found between girls and boys on whether they agreed that these statements applied to them.

In all three heats the students participating in the AHPC were asked about support for being physically active provided by their friends and their teacher. These data have been presented in detail in the three interim reports and therefore only the highlights of the findings are presented here.

SPRING 2009 HEAT

In the survey responses collected during the spring 2009 heat we found that for about two-thirds of the students (61%) their friends were the ones most likely to join them for physical activities (as compared to parents and other adults in family). When asked who encourages them to be physically active, about two-thirds of the students who answered the survey in the spring 2009 said their peers encourage them, and about half said their teacher or coach did.

Therefore, we concluded that the students generally receive sufficient social support for being physically active, with peers co-participating in physical activities and teachers/coaches providing encouragement.

FALL 2009 HEAT

In the fall 2009 we asked more specific questions about the nature of the social support the students received (see interim reports for details), but for the current context we have grouped these questions into two categories, “participating in physical activities” and “encouraging physical activities”, both to provide parallel results to the spring 2009 results and because these represent two general but different categories of support the students can receive.

About 60% of students who answered the survey in the fall 2009 heat said their teacher never participated in physical activities with them (i.e., exercised with them, offered to exercise with them, planned for physical activities in outings, and changed their schedule to be able to participate in physical activities), and only about 5% on average said their teacher participated in physical activities with them often or very often.

On average, 49% of the students said their teacher did not encourage them to be physically active (i.e., gave them helpful reminders to exercise, gave encouragement to stick with exercise program, gave rewards for being physically active, or helped plan activities around the student's physical activities). About 9% of the students on average said their teacher often or very often encouraged them to be physically active.

When asked whether their friends joined them for physical activities, about 26% said that their friends do not, but 16% said their friends join them often or very often for physical activities. These percentages were lower when asked whether their friends encourage them to be physically active, with 48% saying their friends never do so and about 9% saying they often or very often do.

When all categories of social support were aggregated, it turned out that for the students who answered the survey during the fall 2009 heat, they got more overall support for being physically active from their friends than from their teacher (the one most involved in the AHPC). However, this finding seems mostly due to the fact that the friends are more likely to join them for physical activities.

Both teachers and friends reportedly did not often encourage the students to be physically active, and this is surprising, especially given the important role the teachers seem to play in encouraging students within the AHPC.

SPRING 2010 HEAT

As compared to the fall 2009 results, the students who answered the spring 2010 survey on average were less likely to report that their teacher never joined them for physical activities (47% on average said their teacher did not join them for physical activities). In addition, about 13% said their teacher joins them for physical activities often or very often.

When asked whether their teacher encourages them to be physically active, 39% of the students who answered the survey in the spring 2010 heat said they never do, whereas 17% said their teacher often or very often encourages them to be physically active. Therefore, the students report more participation and encouragement from their teachers in being physically active during the spring 2010 heat as compared to the fall 2009 heat.

About 28% of the students said their friends never participate with them in physical activities in the spring 2010, but 20% said that their friends do so often or very often. When asked whether their friends encourage them to be physically active, 41% said their friends never do, whereas 14% said they do so often or very often. It therefore seems that on average the students answering the survey in the spring 2010 report getting more social support from their friends in being physically active than the students answering the survey in fall 2009.

Aggregating the categories of social support showed no difference in terms of the overall average level of social support received from friends as compare to teachers in the spring 2010. Again, we found that friends were more likely to participate in physical activities than the teachers were.

COMPARING THE HEATS

The general finding across the three heats was that friends tended to participate more with the students in doing physical activities than the teachers did. During the first heat we found that the teacher (or coach) tended to encourage the students more than friends in being physically active, but this was not found to be the case in the latter two heats.

It was noteworthy that the students reported more participation and encouragement from their teachers in being physically active during the spring 2010 heat as compared to the fall 2009 heat. A likely explanation is that by the third heat teachers who dropped out of the Challenge tended to be less enthusiastic about physical activities and the Challenge than the teachers still participating (that is, the results are due to selective drop out between the second and third heats). However, there is always the alternative explanation that the sample of students answering the survey in spring 2010 had in general more supportive teachers than students answering the survey in fall 2009.

Motivations for Participating in the AHPC

Respondents were asked to evaluate statements about why they participated in the AHPC. Most of the respondents agreed with statements describing positive reinforcement (the attainment of something desirable) such as helping the school to win, to have fun, and to be healthier. The only statement commonly agreed with that described fear of punishment or failure was “I didn’t want to let down my school”.

It is notable that the majority of respondents said they had been made to participate by either their family or teacher. When asked to provide other reasons for participating, the respondents’ answers fell into one of four categories: 1) Have fun and try something new, 2) get more exercise and be more healthy, 3) to benefit the school or the teacher, and 4) others such as getting out of class and staying out of trouble.

At the site visits, students frequently cited ‘school pride’ and referred to existing rivalries as motivators. While school rivalries are conventionally considered to play out in team sports activities, such as the traditional homecoming game, not all students we spoke to viewed the AHPC as a sport, or even as a team activity. On the one hand, nearly all of our focus groups agreed that collective progress was their main motivation (some combination of school pride, competition or rivalry), but across the 15 schools we visited, views were emphatically mixed about whether the AHPC was a ‘game’ they played as a ‘team’.

Yet, even in schools where the students reported the AHPC as an individual activity, the pull of collective action appeared to be a strong motivator. Exactly what drives this inter-school competition motivator in the absence of traditional team sports sensibilities is unclear. It may be that school affiliation is a powerful enough sentiment on its own. Another possibility is that the teachers' and administrators' desire for the grant money has a secondary effect on the students. In the AHPC, students' step-counts are directly tied to their school's ability to afford new equipment, and in the resource-limited environment of Title 1 schools, this effect might be amplified.

Summary

Students collected steps both on their own, as well as with friends within and beyond the Challenge. They reported that teachers and coaches were sources of encouragement, as well as providers of structure activities for increasing step counts. In particular, students reported more participation and encouragement from their teachers in being physically active during the spring 2010 heat as compared to the fall 2009 heat. A likely explanation is that by the third heat teachers who dropped out of the Challenge tended to be less enthusiastic about physical activities and the Challenge than the teachers still participating (that is, the results are due to selective drop out between the second and third heats). However, there is always the alternative explanation that the sample of students answering the survey in spring 2010 had in general more supportive teachers than students answering the survey in fall 2009.

Overall, students described being motivated to participate in AHPC to have fun, be healthier, and to support a sense of school pride. AHPC, in a sense, became a like other team sports in the school, except that the barriers to participation and success in the "sport" were removed. The students reported that they changed their behaviors, making conscious choices to walk more than they had previously, as well as trying new activities to increase their step counts. Some of these activities might be considered borderline cheating. In particular, we observed (and students reported) tapping their feet on the floor repeatedly while seated at their school desks in order to increase their step counts artificially.

In the interviews and focus groups, students identified school pride and a desire to win the inter-school competition as significant motivators in playing the AHPC, but views were mixed on whether the AHPC is a team sport. Students reported enjoying the horse avatars, but we found little evidence that the ability to 'bling' their horses contributed significantly to student motivation. Students appeared to spend little

time checking out each others' horses, and thus the identity presentation and social comparison motivators were less effective than inter-school competition.

Student Physical Activity over Time as Recorded by Actipeds

The analysis of steps is based on the steps logged everyday day during the AHPC, over the course of 11 months (April 2009 to February 2010). This includes the three heats, and one week of step data collected with the pedometers before the game's website was launched (pre-game). In total, there are 111,938 entries in the step database. A single entry represents the number of the steps every student logged with the pedometer each day.

We also analyzed how often each AHPC participant logged into the website in the last two heats (November 2009 to March 2010). In total, there are 813 entries in the website login database, each representing how often a particular student participant logged into the AHPC website during the second and third heats of the AHPC.

Some of the entries in the step database are missing values. This means that the system did not receive data from the pedometer for that specific day. This might happen for various reasons; such as the battery of the pedometer ran out, the wireless transmission of data from the pedometer to the station was interrupted, or the student lost the pedometer. As it is not possible to identify what exactly happened or recover the data the data analysis excluded the entries with the missing steps. It is noticeable that the percentage missing step data increased over time as shown in Table 1. This increasing rate of unrecorded data may have certain effects on the students' involvement in the Challenge, which will be discussed later.

Table 1.

The percentage of missing step data in pre-game and three heats.

Time period	Number of entries	Percentage of entries missing step data
Apr. 20 – Apr. 26, 2009 (Pre-game)	6121	27.9%
Apr. 27 – May 22, 2009 (Heat 1)	38506	33.1%
Nov. 16 – Dec. 11, 2009 (Heat2)	17437	39.0%
Jan. 4 – Feb. 5, 2010 (Heat 3)	22503	57.7%

Note: The data between heats are not analyzed since some schools took the pedometers away from students during the school break and some did not.

Step Distribution

The daily average number of steps per student is 4193 (1.59 miles[2]) during the AHPC, with a median of 3960 (1.50 miles) and standard deviation of 2347 (0.89 miles). The smallest daily average number of steps per student is 0 and the largest is 13058 (4.94 miles). The distribution of daily average number of steps is shown in Figure 1. The histogram chart is similar to a normal distribution leaning towards the lower end. Note that 85 students averaged fewer than 500 daily steps, which is unrealistic. It shows that either the devices (pedometer or wireless station) failed to function, or the students did not put the pedometer on to collect steps.

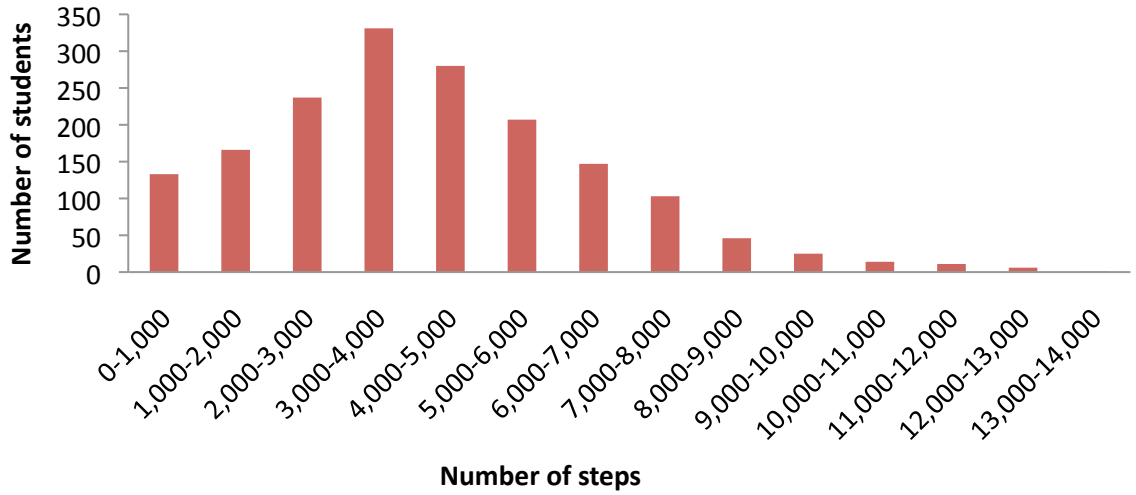

*Figure 1.*Distribution of the number of students logging an average number of steps per day.

Difference between Weekdays and Weekends

We analyzed the pattern of step accumulation by each day of the week (see Figure 2). The average number of steps logged on weekends is significantly smaller than the number logged on weekdays for the pre-game period and all three heats (Pre-game: $t(1857) = 12.63$, $p < .001$); Heat1: $t(9213) = 39.36$, $p < .001$); Heat2: $t(4252) = 29.89$, $p < .001$); Heat3: $t(3729) = 28.90$, $p < .001$).

[2] The conversion ratio from the steps to miles is 2643:1 according to AHPC website.

This difference in number of steps logged on weekends as compared to weekdays might be caused by the fact that not all students wore pedometers during the weekends. According to the survey, 78% of the students wore the pedometer “always” or “most of the time” on weekends, compared to 98% of them who wore the pedometer with the same frequency during weekdays. We accounted for this factor by dividing the number of steps during the weekends by 78% and during the weekdays by 98%. Even after doing that, there were still significant difference in the number of steps between weekdays and weekends. Therefore, the hypothesis that the students got fewer steps on weekends because they did not wear their pedometers was not supported.

There were a few other explanations for the lower step numbers during the weekends than weekdays. It might be that the home environment of the students who participated in the AHPC provides less opportunity for physical activities in general. Students get less organized activities at home than at school. Especially during the AHPC, some of the teacher organized extracurricular activities for the AHPC participants, and the peer pressure from other AHPC participants at school may contribute to the increased level of physical activities at school. Another explanation is that peers play a more important role for the kids when it comes to physical activities as shown in the survey. During weekends, the kids might have fewer opportunities to share time with their peers, friends, classmates etc. A third explanation is that students might have viewed the AHPC as a school project and tended not to change their home behaviors during the weekends.

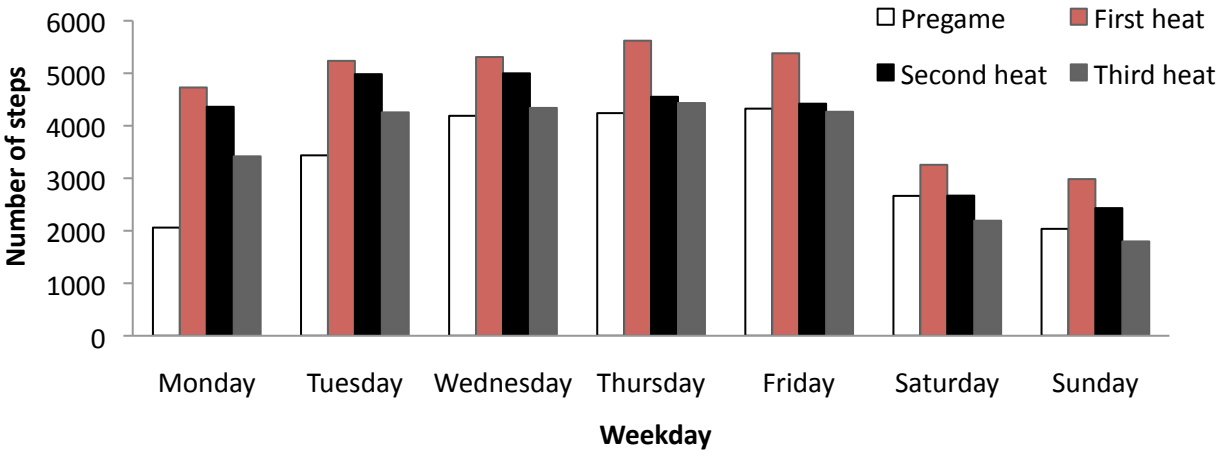

Figure 2. The average number of steps for each day of the week for the pre-game period and all three heats.

Steps During the Pre-Game Period and the Three Heats

The AHPC was deployed three times over the course of 11 months. Table 2 shows the number of participants for each of the heats and the pre-game period.

Table 2.

The average, standard deviation, and median of daily steps for pre-game and three heats.

Time period	Number of participants	Average nr of steps	Standard deviation	Median
Apr. 20 – Apr. 26, 2009 (Pre-game)	853	3416	3420	2668
Apr. 27 – May 22, 2009 (Heat 1)	1333	4822	4086	4292
Nov. 16 – Dec. 11, 2009 (Heat2)	614	4236	3764	3534
Jan. 4 – Feb. 5, 2010 (Heat 3)	506	3723	3509	3120

To find if there are significant differences among the pre-game and three heats, we conducted a one-way Analysis of Variance (*ANOVA*) and followed it up with Tukey's post-hoc tests. There was an overall significant difference among the four defined periods (pre-game and three heats; $F(3,50293) = 300.60$, $p < .001$). More specifically, there was a significant difference between each pair of heats ($p < .0001$ in each case).

The results indicate that compared to the pre-game period the physical activity level of the participating students was higher during the three heats as they logged more steps in each heat compared to the pre-game. However, in the course of the AHPC the number of steps logged by the participants decreased as the first heat had the largest number of steps, then the second heat, and finally the third heat. To explore possible causes of this trend, we did further analysis and the results of which are provided in the following sections.

Long-Term Change in Steps over Time

Among the 1744 students who participated in the AHPC for at least one of the three heats, 1377 students joined during the first heat, 316 students joined during the second heat, and 51 joined during the third heat. There were 211 students who remained active in the Challenge in all three heats. We analyzed the change in number of steps over time for these students and Figure 3 shows the average daily steps of this group in the course of the 11 months of the AHPC. The average steps of the pre-game period was 3649 (*SD* = 3208), the average for the first heat was 5252 (*SD* = 4227), the average for the second heat was 4154 (*SD* = 3545), and the average for the third heat was 3651 (*SD* = 3180).

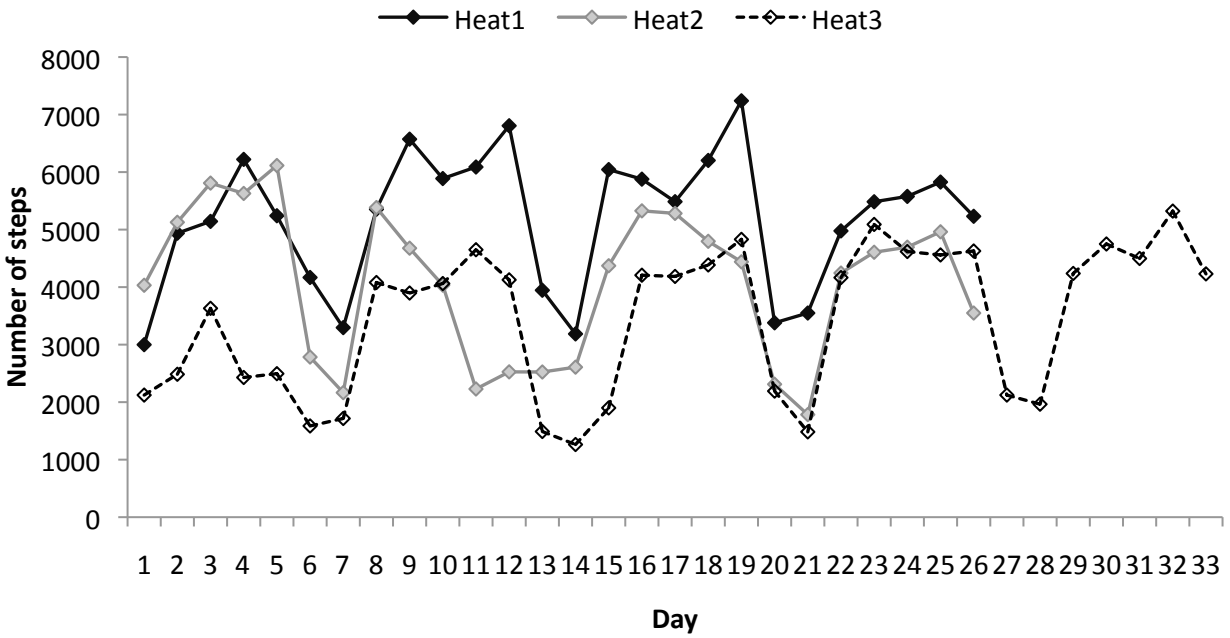

Figure 3. Average number of steps for participants who participated in all three heats for each day of the Challenge.

A one-way *ANOVA* showed a significant difference in the number of steps among the four periods (pre-game and three heats; $F(3, 12788) = 142.49$, $p < .001$). A further post-hoc analysis with Tukey's showed that the difference was between the pre-game and the first ($p < .001$), and second heats ($p < .05$) respectively. There was not a significant difference between pre-game and the third heat ($p > .05$). In addition, there was a significant difference in the number of steps logged among the three heats: There were significantly more steps logged in the first heat compared to the second, and more steps logged in the second compared to the third ($p < .001$ in all cases).

This drop in steps over the three heats might be explained by several factors. First, the novelty of the game might have faded over the time. To explore this we compared the number of steps logged by

newly joined participants to number of steps logged by students who had started in an earlier heat (discussed in the following section). Second, the students might have been discouraged by malfunctioning pedometers. From the site visits, we learned that the students were aware of failure of the data recording and upload, and felt frustrated as a consequence, especially when they put time and effort into getting steps that were not uploaded to the system. In addition, there is a huge seasonal change from April-May to Jan-Feb. A few northern states (e.g. PA, IL, SD, and MT) were snowy and cold while some other states were rainy (OR) in the winter, reducing opportunities for outdoor activities (and reducing the possibility of wearing footwear that accommodates the Actiped's clip). In addition, when we were trying to arrange school visits in Jan-Feb 2010, a few schools turned us down because they were under the pressure of state academic tests, saying that neither the teacher nor the students had time to host our visit because they were spending most of their time in the classroom preparing for the tests.

One of the initial goals of this research was to find if interventions like the AHPC has a sustainable effect on kids' physical activity level. We saw a boost in physical activity in the first heat where the Challenge started, but the number of steps dropped constantly. Future system designs need to consider the following factors. It is hard to hold long-term attention for the age group of 12-13 because the students are constantly attracted by new events in their life; the weather change had impact on the activity level; and the schedule and priority change of the schools also have an effect on the time spent on physical activity.

Comparison of Students who Joined in April 2009 and November 2009

We assumed that the students who joined in April 2009 had the same external conditions (i.e. school facilities, weather, and neighborhood walkability) as those who joined in Nov 2009. By comparing their steps, over time, we can investigate if there is significant difference in steps for students who joined in the first heat and those who joined in the second heat. As a result, we can find out if there exists novelty effect for the AHPC among the age group of adolescents. Novelty effect is the tendency for performance to initially improve when new technology was introduced, not because of any actual improvement in learning or achievement.

In the first heat, 1377 students joined the AHPC, of whom 304 remained in the second heat. In the second heat, 316 students joined the AHPC. The average number of steps that these two groups logged

over time in the second heat is shown in Figure 4. There was a significant difference in steps between these two groups ($t(10433) = -4.25$, $p < .001$, (two-tailed)), indicating that the students who started in the first had significantly smaller number of steps during the second heat than the students who started in the second heat.

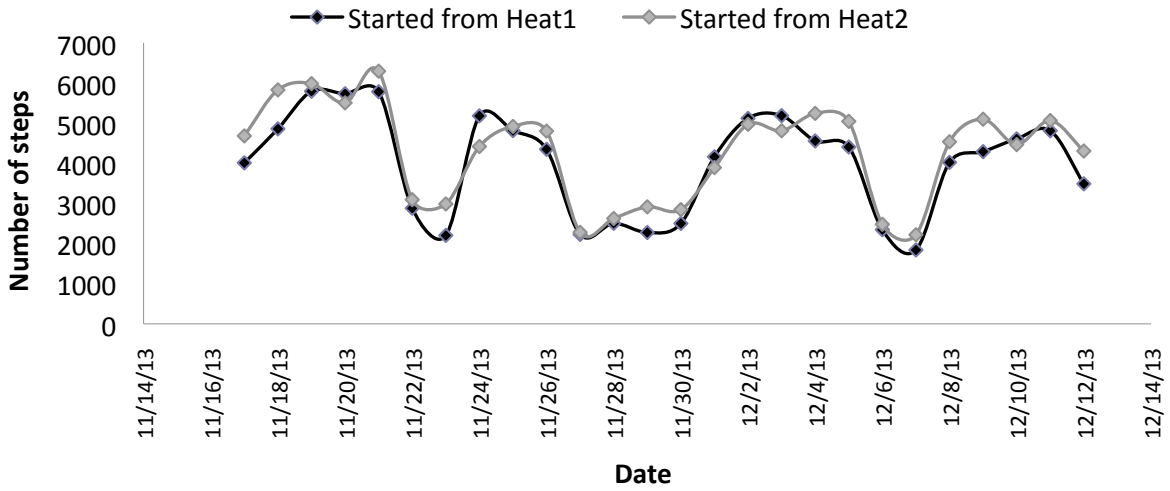

Figure 4. The average daily number of steps during the second heat, for the students who started in the first heat and the students who started in the second heat.

There were only 51 new students that joined the Challenge in the third heat. The number of students who joined in the first heat was 246 and the number of students who joined in the second heat was 208. Since the number of students who joined in the third heat was much smaller than the first two heats, we could not meaningfully compare it with the other two groups. The students who joined during the first two heats did not log significantly different numbers of steps during the third heat.

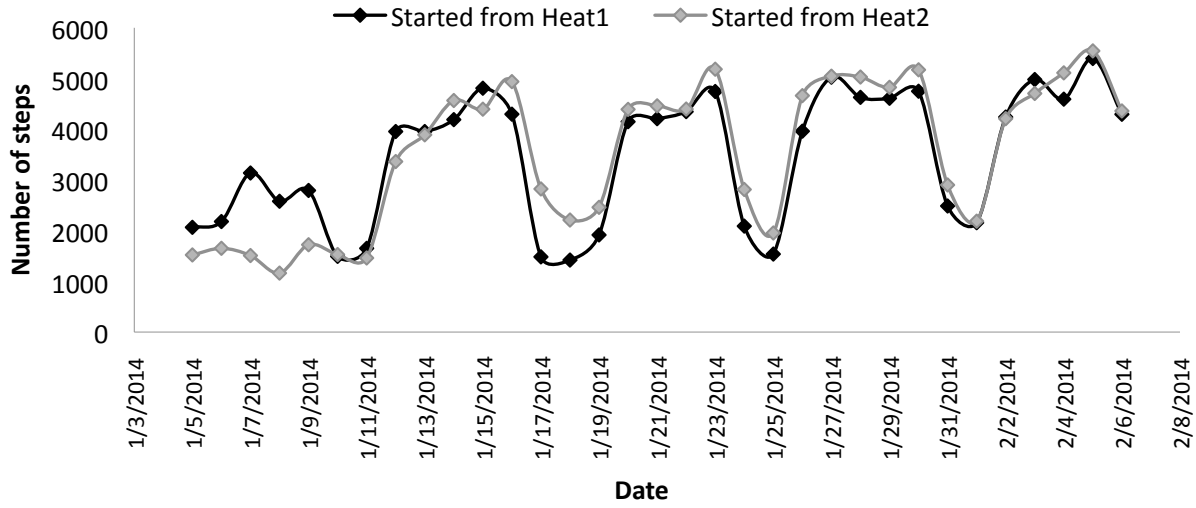

Figure 5. Average daily number of steps during the third heat, for the students who started in the first heat and the students who started in the second heat.

These results show that the newly joined participants did log more steps than those who had been in the Challenge for a few weeks. The difference, however, disappeared with time. This finding shows that the novelty effect (the participants are more excited at the start when the game is new than later when the game has become more familiar) for the system is indeed an important factor for changing physical activity level for the age group of 11-13.

Website Login Analysis (November 16, 2009 to February 5, 2010)

On average, the students logged in to the AHPC website 9.2 times from Nov. 16, 2009 to Feb 5, 2010 (*SD* = 12.9). The lowest number of login occasions was one and the highest was 113. Figure 6 shows the distribution of students in relation to number of times of logging in to the AHPC website. In Figure 7, we applied a Log function to the number of the students and the number of times logging in to the AHPC website. The results show that the majority of the students did not use the website very often, while a small percentage of them logged into the website extensively.

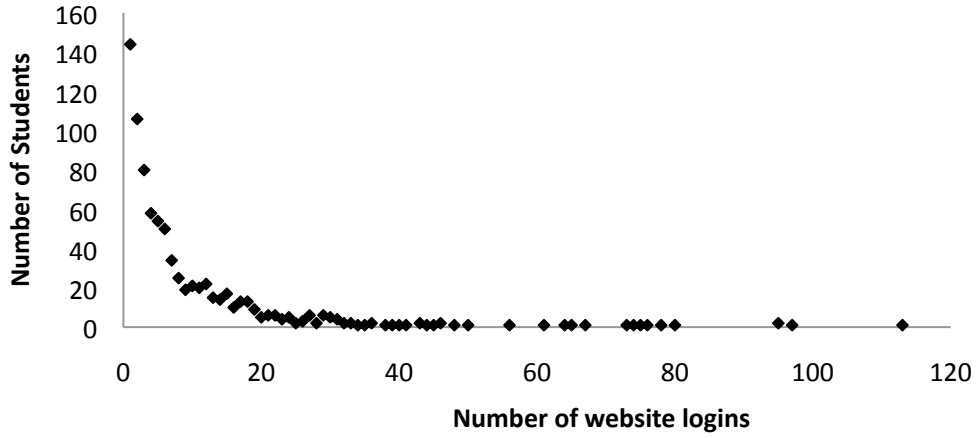

Figure 6. Distribution of students in relation to the number of times of logging in to the AHPC website

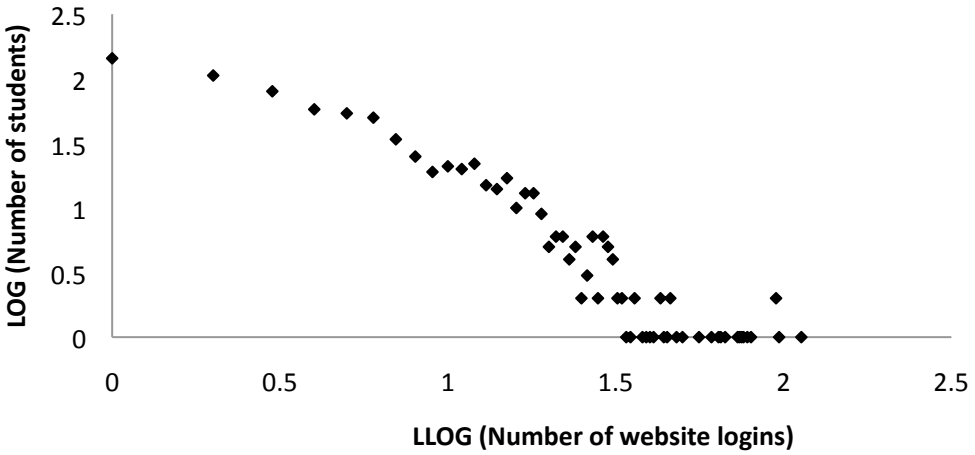

Figure 7. Distribution of students in relation to the times of logging in the AHPC website, with a Log() function applied to both axes.

In the survey questions for the students' computer and Internet usage, we found that 60% of the students had at least half one hour of Internet access every day either from school or at home. Therefore, accessibility was not the reason why logins were distributed so unevenly. From the qualitative data, we found that the students did not develop a habit of visiting the website due to a variety of reasons. The most frequently mentioned ones were: Limited opportunities for real time interaction on the website, lack of interest in using the website, and forgetting username or password.

We also calculated the average number of times students logged in to the AHPC game for each school, and the ordered result is shown in Figure 8 (note that a single data point on the graph represents one school). There was a positive correlation between website login frequency and steps. Those schools with a high average website logins tended to have more steps ($r = .77$, $p < .001$).

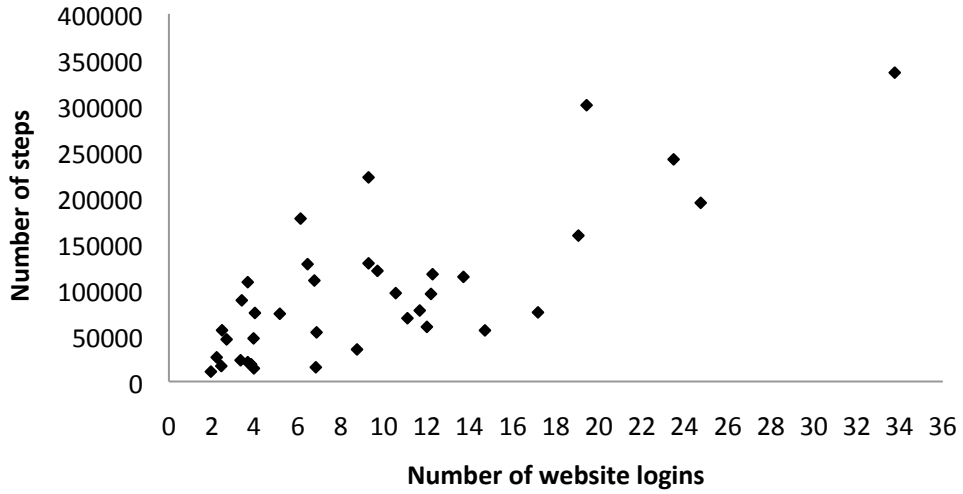

Figure 8. The website logins and the number of steps for each school (a data point represents a single school).

To further explore this, we did a correlation analysis on the individual level as well (that is, for each student as opposed to aggregated by school), and it turned out that the frequency of website usage had a significant positive correlation with the number of steps on the individual level (r = .49, p < .001). This indicates that the students who logged onto the AHPC website more often also tended to have more steps. It is unclear whether this correlation is due to the students who are more active checking out the website more often or because visiting the website encouraged more physical activity.

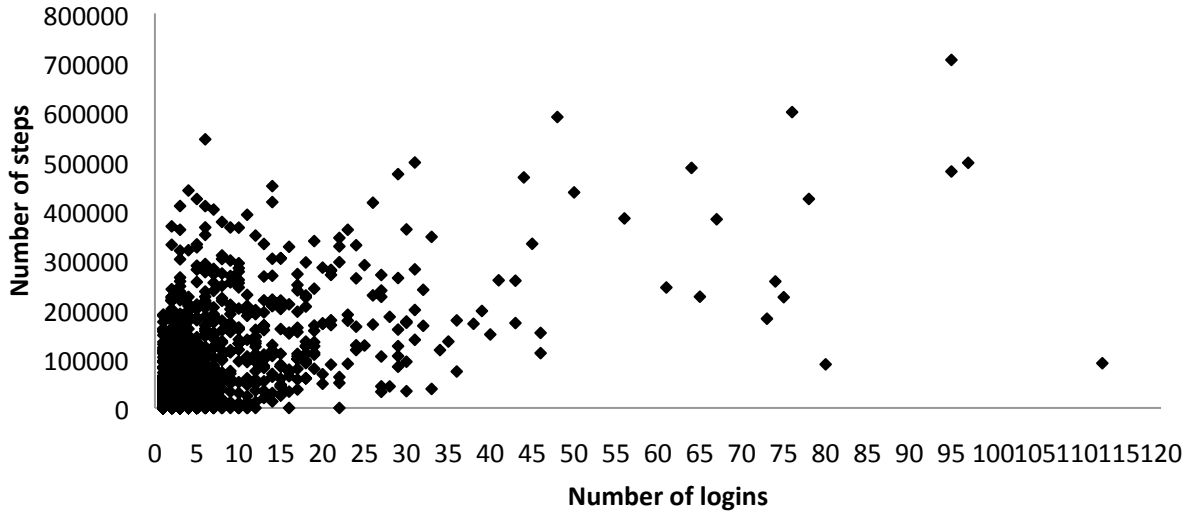

Figure 9. The website logins and the steps for each of the students.

Summary

Compared to the pedometer data collected one week before the AHPC was deployed, the participants logged significantly more steps during the three heats as compared to the pre-game period. This finding showed that the AHPC did indeed encourage the students to get more steps and was robust even when novelty effects and seasonal differences had been taken into account.

However, we did find a significant novelty effect of the AHPC among participants (11-13 year old middle school students). Students who joined the Challenge in the second heat logged more steps during the second heat than the students who had joined the Challenge in the first heat. This finding showed that the novelty of participating in a game of this kind had an important motivational effect.

The students accumulated significantly more steps during weekdays than on weekends, indicating the important role the school environment and peer influence play in this context. Although students would be expected to have more free time on weekends, they had more steps during the weekdays, indicating that there still is a larger space for increasing activity levels during weekends.

The number of website logins was strongly (positively) correlated with the steps, implying a relationship between involvement with the AHPC system and physical activity level. The students who got more steps tended to log in the website more frequently. Although the activity of logging into the website itself did not increase the step number directly, it was an indicator of the involvement level with the Challenge.

The Teacher, School Environment, and Managing the Game

In this section, we report the findings of data gathered from the teachers involved in the AHPC through surveys and on-site interviews.

The findings in this chapter are mainly from the online teacher survey we sent out after the AHPC finished (March 2010) which asked about opportunities for physical activities the students have at the schools, and the perceptions the teacher holds about the impact of the AHPC. The results from the first teacher survey were reported in detail in the October 2009 interim report, and therefore we only present the overview of those findings here.

In addition, we analyze findings from the site visits and teacher surveys pertaining to how the Challenge was managed and what was needed to get the AHPC to work at the school. In particular, we analyze the role of the different stakeholders in the Challenge, the integration of the Challenge into the school culture and schedule, the issue of resources, and the specific role of the teachers.

School Opportunities for Physical Activity

We asked the teachers involved in the AHPC to answer surveys at two different points: During the Spring 2009 heat and during the Spring 2010 heat. We reported on the results of the first survey occasion in the first interim report and we will therefore only summarize the highlight of those findings here. What follows is therefore a more detailed analysis of the responses from the second teacher survey.

In the first teacher survey, we primarily asked questions about the opportunities the students had at the school to be physically active. We received responses from 17 schools participating in the AHPC in the Spring 2009 heat. What we found is that the schools seemed to provide a variety of ways to encourage the students in being physically active. Most schools provided outdoor recess and physical education classes were offered in all the schools either daily or few times a week. In addition, all the schools offered opportunities for participating in team sports as extracurricular activities and most also offered competitive individual sports. Therefore, the schools that responded seem to offer the students opportunities, both mandatory and voluntary, for being physically active.

As has been detailed earlier, we did change the teacher survey somewhat between the two survey occasions. Mostly we did this to get data that are more detailed on opportunities provided by the schools for the students to be physically active, but also to get information on how the teachers integrated the AHPC into their schedule, organized participation, and dealt with problems.

In total, we received responses from 19 teachers in the Spring 2010, each from a different middle school. The return rate was 51%. Fourteen of the teachers taught 6th grade, another 14 taught 7th grade, and four taught 5th grade. Two of the respondents taught math class, one was a vice principal, one taught various classes, and fifteen teachers taught physical education classes (PE). Ten of the teachers taught all the AHPC students in their school, and eight taught some the AHPC students.

Schools provided a variety of opportunities to support the students to be physically active. The opportunities included PE class and recess, and extra-curricular activities of various programs (e.g. sports and clubs) and other external initiatives.

PHYSICAL EDUCATION CLASSES AND OUTDOOR RECESS

Most of the schools provided PE classes on a weekly basis, and some schools had seasonal changes to the PE schedule. Nine (64%) schools gave PE class every day, four (27%) schools had PE a few times a week, and one (7%) school had one PE class per week. Three teachers stated that there were seasonal changes for PE classes; two said that the PE class was moved indoors during the winter, and one stated that their sixth graders took turns having PE classes every other semester.

Comparatively, outdoor recess was not common in these schools. Eleven (58%) of the schools did not have outdoor recess hours at all, six (32%) had it once a day, and two had it more than once a day. The majority (80%) of the outdoor recess sessions lasted less than half an hour.

EXTRA-CURRICULAR ACTIVITIES

Schools provide various extra-curricular activities to the students. The top four most frequently mentioned categories were “competitive individual sports (e.g. track, dance, swim team)” (89%), “band, orchestra, or choir” (84%), “competitive team sports (e.g. football, soccer, baseball, cheerleading)” (79%), and “free time in the gym” (53%). These activities were the most popular in these schools.

Aside from the opportunities provided by the schools, local communities also provided a variety of programs. The top three most frequently mentioned categories were “competitive team sports (e.g. football, soccer, baseball, cheerleading” (84%), “competitive individual sports (e.g. track, dance, swim team)” (58%), and “scouting groups” (58%).

There were also external initiatives supported by the state or health related organizations to encourage students to be physically active. Nine out of the 19 (47%) schools had participated in such programs, including Shaquille O’Neal Wellness Wheel, School Fun Day, Health coalition, Run for Arts, Jump Rope for Heart, Pedometer Fit Club offered by the teacher, The Arizona Nutrition Network, NRG, a new soccer team, and archery competition. The teachers were asked to compare the AHPC with these programs. Four out of the nine teachers rated the AHPC to be better (44%), three rated the AHPC to be about the same (33%), and one rated the AHPC to be worse (11%).

Teacher Perceptions of AHPC and Health Behavior Changes

In the second teacher survey, educators were asked about the effect of the AHPC on the participating students. The teachers' impressions on the AHPC’s effect on the students are grouped into two main themes: General feedback on the AHPC’s effect and the novelty effect.

GENERAL FEEDBACK ON THE AHPC’S EFFECT

We asked the teachers about the effect of the AHPC on the students and themselves. Table 1 shows the teachers' opinions on how the students were affected.

Most teachers agreed with the statements “they increased their physical activities”, and “they got more excited about being physically active”. Ten of the teachers were not sure if the students “got more involved with organized physical activities at school”, suggesting that for these schools the AHPC participation did not lead to changes in participating in organized physical activities. It is noteworthy that generally the teachers did not disagree with the statements, indicating that the teachers saw positive benefits of participating in the AHPC for the students in terms of being enthusiastic about and involved in physical activities.

Table 1.

Teachers' opinion on how the students were affected by the AHPC.

Statements about effects of the AHPC	Disagree a lot	Disagree a little	Neither agree or disagree	Agree a little	Agree a lot
They got more excited about being physically active	0%	0%	18%	53%	29%
They increased their physical activities	0%	0%	12%	47%	41%
They tried out new ways to be physically active	0%	6%	35%	35%	24%
They talked more about being healthy and physically active	0%	6%	41%	29%	24%
They got more involved with organized physical activities at school	0%	0%	59%	29%	12%
They got their families involved in being physically active	0%	0%	41%	41%	186%

The teachers also had differing opinions about which groups of students were most affected by participating in the AHPC. Eight teachers (47%) believed that all the students were influenced to be more active in general, while two (12%) believed that the students' activity level had not changed. Five teachers (29%) believed that students who were already active became more active in the course of the AHPC, but the less active students did not change their activity level. Two (12%) teachers believed the opposite to be true: Less active students became more active in the course of the AHPC but students that are more active did not.

When asked about long-term effects of participating in the AHPC, most of the teachers agreed with the statement "the students have a better understanding of what it means to be physically active" (76%). A fourth of the teachers thought that "the students will be more physically active in the long-term" and "the students have a better understanding of what it means to be healthy" because of participating in the AHPC.

NOVELTY EFFECT

Novelty effect is the tendency for performance to initially improve when new technology is introduced, not because of any actual improvement in learning or achievement. The teacher survey confirmed that the AHPC did have a strong novelty effect on the students (see Table 2). Thirteen teachers (68%) agreed with the statement "the students were very excited to participate when first starting the Challenge", but the majority also agreed that the excitement faded out over time (75%). The teachers were generally not sure whether the students would have liked to continue to participate after the Challenge ended, indicating some ambivalence in enthusiasm for the Challenge at the end.

Table 2.

The novelty effect of the AHPC.

Statements about the novelty of the AHPC	Disagree a lot	Disagree a little	Neither agree or disagree	Agree a little	Agree a lot
The students were very excited to participate when first starting the Challenge	0%	0%	6%	13%	81%
The students became less excited about participating in the Challenge over time	13%	0%	13%	63%	13%
The students became more excited about participating in the Challenge over time	7%	20%	53%	7%	13%
The students would have liked to continue participating in the Challenge after it ended	6%	0%	38%	31%	25%

The teachers gave a few explanations why they thought the students' excitement changed over time. The comments can be categorized into three subgroups. First, let us examine technological glitches. As indicated in the step data, 58% of entries had empty step number, meaning that these pedometer data was not properly collected or uploaded, which caused frustration that turned students away. The following comment illustrates for example the difference in students' enthusiasm between the heats when the pedometer was working well and when the pedometer stopped working:

"Some of them were less excited when they could not see these results. When they would be very active and would see zero steps, they felt discouraged. They were obsessed with checking their steps. It

was a very different experience this time when the pedometers did not work. In our first trial when everything was working, the excitement, energy and activities were elevated to a near frenzy. This time it was a very different experience. The pedometers really need to work. One or two malfunctions are understandable but for all of them to stop really has a negative impact on the moral of participants."

Another technological issue mentioned by two teachers was the limited Internet access at school and at home. During the site visits, we also found that some of the students did not have computer access at school. Even for those who had computer classes time on the Internet was typically driven by structured activities, rather than activities of the students' choosing.

A second factor that explained the change of enthusiasm was schedule changes. When students transitioned between the sixth and seventh grades, their teachers typically changed. Over the time that the AHPC was deployed, some of the teachers stopped teaching the participating students and had a difficult time meeting on a regular basis any more. As one of the teachers mentioned, "I did not teach them during the 2nd heat so I was unable to motivate them daily as I did before Christmas." Another schedule change was addition of academic exams and other projects during the school year that made the students and teachers busier, leaving them less time for physical activities and focusing on the AHPC.

A third factor was the weather. A few teachers mentioned that in the winter students did not have as many opportunities for physical activities as they could not spend as much time outdoors.

Beyond the above reasons, one comment about the lack of family support stood out*:*

> Children in our community don't look at things long term. There is little support from home and finances are low.

Although only one teacher mentioned this aspect, it showed that there were other factors that influenced the long-term effect of the AHPC beyond the school environment. We discuss some of these in the home environment chapter.

Managing the Game

Many different people and artifacts that must work together in order to have the game function within a school's setting; our findings suggest that programs like AHPC are not "drop-in" technologies; to set up the game, manage student participation ,and manage equipment requires a non-trivial amount of

effort from a variety of stakeholders. In the next section, we take a more detailed look at the different *stakeholders* involved in the AHPC and their interrelations.

STAKEHOLDERS

Even the simplest task of uploading steps requires the participation of teachers, administrators, students, IT professionals in the schools, and Humana representatives, as well as the pedometers and base stations themselves. Therefore, as we analyzed the focus groups and interviews from each school, we sought to identify the people, organizations and artifacts that work together to create the AHPC. The result of our analysis is a stakeholder network that shows a snapshot of the complex, interdependent set of relations between people and technology involved in the AHPC. In this section, we provide a simplified visualization of the stakeholder network (see Figure 1) and describe various relations between stakeholders that emerged from our research.

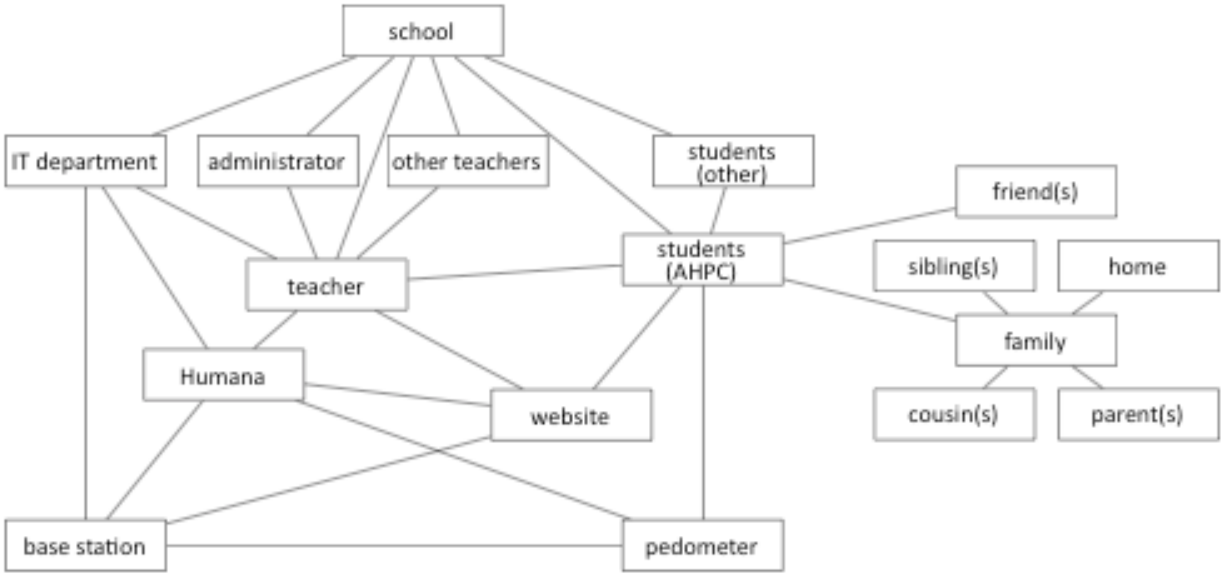

Figure 1. Simplified stakeholder network.

This stakeholder network is a direct result of our qualitative analysis process. As we coded each transcribed interview and focus group, we noted each time the students or teachers mentioned other artifacts, organizations or people associated with the AHPC. Sometimes we explicitly drew out comments about specific stakeholders — we asked all participants about the pedometers, for example. However, other stakeholders emerged from seemingly unrelated questions. We never explicitly probed students about their extended family, for example, and yet many students brought up a cousin or cousins during various parts of the interview.

In Figure 1 above, the lines between the stakeholders can stand for various kinds of connections. For example, one interesting part of the network is the feedback loop for students' step counts. Each student wears a pedometer, which transmits step data to the base station, which sends that data to the website, which students can access to see their progress. In the focus groups, many students mentioned the long feedback loop between carrying out an activity and seeing the results of that activity. The stakeholder network illustrates the long path the activity data must take in order to return to the students.

In the case where there was some technical problem with step counts being recorded, other parts of the network were activated. The student would check the website and see no new progress recorded, and then mention it to their teacher (in this case, referring to the teacher primarily in charge of the AHPC at the school). The AHPC teacher would then attempt to troubleshoot the problem by contacting Humana. In the graph above, we have grouped all Humana representatives together, but in this case, the teacher would deal with a project manager, who might send a replacement pedometer. However, sometimes all the participating students in a school might be unable to register their steps. In this case, the teacher might now be negotiating with the school district's IT department, the Humana project manager, and even a representative from the pedometer and base station provider in order to solve the issue.

WHO IS A USER OF THE SYSTEM?

Another result of the stakeholder analysis is a more nuanced picture of the various 'users' of Horsepower Challenge. Before conducting our on-site visits, we assumed that the students participating in the AHPC were the primary users of the system. They are, after all, the people whose behavior and attitudes the system seeks to change. However, in our visits and analysis, several other key stakeholders emerged. On the graph, they show up as hubs with many spokes. The students form one such hub, but so do the school and the AHPC teacher. One of the initial design goals of the AHPC was to run the game independently without the help from teachers. However, we found that teachers held a key position in the ecological system where the AHPC was deployed, as shown in Figure 1. They are problem-solvers when the pedometers fail to work; they are motivators to organize students' physical activities and praise them for their progress; they are communicators with other teachers and administrators who may provide more recourse for physical activities. Due to their unique and indispensible roles, we suggest that systems deployed at school need to design *for* the teachers and involve them as active members. That the school forms an important stakeholder is no surprise; it is the environment in which

Horsepower Challenge primarily takes place, the institutional setting within which the Challenge is regulated, and which gives many of the incentive structures (social comparison of horses, inter-school competition, grant awards) their meaning. Humana, as the providers of the game, ought to be central, and indeed Humana is directly connected to five other stakeholders throughout the game (and was most likely connected to an administrator in each school, although our data do not mention this connection directly).

INTEGRATION OF AHPC INTO AN EXISTING SCHOOL CULTURE

The school is the central environment in which the AHPC plays out. While the physical activity recorded by the pedometers may and did occur anywhere throughout the student's week, the school environment regulates the interaction of students, teachers and administrators. In our qualitative analysis, we have identified three main facets of the school environment that affect the AHPC: resource availability, the daily schedule, and the AHPC teacher.

RESOURCE AVAILABILITY

A prominent feature across schools in the AHPC is the high percentage of students who receive free or reduced lunch, suggesting that the schools may be in low-income neighborhoods. Some of these schools actively apply for and receive grants for technology improvements or after-school programs, or are affiliated with a non-profit organization that provides funding for auxiliary services or capital improvements in the school. However, many of the AHPC schools struggle from insufficient funding in ways that have direct impacts on the AHPC experience. When the AHPC is deployed in these schools, this limited resource presents two primary challenges: computer infrastructure and gym resources.

In the teacher survey, teachers cited limited Internet access or slow computers as one of the primary demotivating factors in the AHPC, and we saw evidence of this in our site visits as well. Computers in the schools are typically aging (5-15 year old computers), Internet connections are slow, and the computers that children have access to the most frequently are typically the worst in the school. The processor-intensive and high-resolution AHPC website placed a strain on computers.

We saw that the "best" computers in the school were placed in computer labs shared among all teachers. These lab computers typically required advance booking to use, and a disruption to normal class routines, as computer labs could be a 10-15 minute walk from the classroom.

The AHPC also requires some involvement from school IT personnel, who were often over-worked and unable to resolve technical difficulties with the base stations or website access as quickly as the teachers would like.

Additionally, many of the schools we went to lacked adequate gym resources. For example, in School 10, the school did not have a roofed recreation area for the students, an especially challenging limitation in a rainy north-western city.

DAILY SCHEDULE

The pressures of limited financial resources are also related to another issue affecting the AHPC participants: limited free time. Few schools we visited offered regular recess, and students' lives while in school are heavily scheduled. This meant that there was little room during the school day for additional activities, especially exercise. Indeed, in our transcript analysis we found a striking correlation between mentions of AHPC-related exercise and terms like 'outside' or 'the outdoors,' suggesting that students had to look outside the school environment for ways to increase their step-counts. This presents a challenge to the AHPC, since its motivational structures appear to be centered on the school environment (as discussed in the 'student' section of this report). Additionally, the lack of any AHPC-specific after-school events created a challenging learning curve and complicated participants' views of the AHPC as a game (discussed in the 'gameplay' section).

As authority figures with a limited ability to adjust the daily schedule, the AHPC teachers became instrumental to finding ways around the time constraints. Teachers from several schools extended the school day, opening the gym before school for those taking part in the AHPC. Other teachers allowed the AHPC students free access to the gym during a free period or homeroom, even if another class was already using the gym. Some AHPC teachers changed their PE classes to include more step-friendly activities. Non-PE teachers found ways to work physical activities into their lectures, encouraging students to take short walking breaks, for example.

In the teacher survey at the conclusion of the Challenge, we asked the teachers about how they integrated AHPC into the students' daily schedules. Seventeen teachers answered this question, and Table 3 shows their answers. Other than three teachers who did not incorporate the AHPC into existing school activities at all, the other 14 teachers incorporated the AHPC into their classes. The students who participated in the Challenge also received more opportunities to use the computer and gym facilities.

Table 3.

Percentage of teachers agreeing with statements describing the way that the management of AHPC within the school.

Statement	Percentage of teachers who agreed with each statement
It was incorporated into PE class	53%
Participating students were allowed to use computers when they had time (e.g. after finishing lessons or during recess)	41%
Participating students were allowed to use the gym facilities when they had time (e.g. before first period or during recess)	35%
It was incorporated into a non-PE class	35%
Specific time was set aside for the Challenge where all the participating students would meet	29%
It was incorporated into after school programs	6%

THE AHPC TEACHER

The AHPC teacher is the most connected stakeholder in the AHPC stakeholder network. The teacher is connected directly to the AHPC students, Humana, school administration, other teachers, IT department, and the rest of the school, as well as monitoring the students' progress using the website. The teacher is also connected less directly to the AHPC students' parents, non-AHPC students, the base station itself, and the pedometer (which many teachers wore in the second and third heats).

In their relations with other stakeholders, teachers take on various roles. They select the students to participate in the AHPC, help the students find or replace lost pedometers, generate excitement about the program among students, and report technical problems of the pedometers and RAP to the school IT support or Humana. They also must solicit support from other teachers and school administrators.

In general, the teachers found the AHPC moderately time-consuming. In the teacher survey, Eight out of 17 teachers (47%) agreed that the AHPC was somewhat time-consuming, six (35%) agreed that the AHPC was not time-consuming and three thought that the AHPC was very time-consuming (two did not answer the question).

In our analysis, two major factors appear to affect teachers' ability to effectively manage the AHPC and motivate the students. The most important appears to be the degree to which the teacher has access to the students on a regular basis. Another factor is the teacher's core subject. This expresses itself in two ways: first, access to facilities conducive to physical activity and regularly scheduled time with appear to be important components of a successful AHPC deployment. We found that teachers in "non-core" subjects (e.g. those not subject to standardized testing requirements) had more flexibility integrating AHPC into their classroom activities. PE teachers certainly have an advantage in this regard, though teachers in other subjects, with support from the school's administration, may have flexibility to include physical activities into daily lessons (e.g. taking children on a nature walk in a science class or re-enacting a historical battle outdoors in a history class). Teachers who had all of the AHPC students in a single class had an easier time providing opportunities for structured physical activity options, as well as access to computer resources.

Note also that one effect of the within-subjects longitudinal design of the AHPC is the increased difficulty of student-teacher contact. As students moved from the sixth to the seventh grade, the AHPC teachers often lost daily in-class access to their AHPC students. This affected all teachers, but subject teachers were hit by this transition the hardest, because teachers typically specialize in a certain grade level. Because of the teacher's central role in managing the school environment, we feel it is imperative that regular student-teacher contact be prioritized in order for the AHPC to be most effective.

Finally, across the schools we visited, most experienced funding constraints for PE as compared to academic subjects. The teacher survey indicated that although the student population in the AHPC schools ranged from 140 to 2000, the number of PE teachers ranged from 1-3, creating an average student-to-teacher ratio of 247:1; given the lack of support for PE within schools, integrating activities such as AHPC into non-core subjects may provide additional opportunities to integrate health and wellness activities within K-12 settings.

Summary

Schools in the AHPC represented a variety of urban to rural environments, but all experienced limited resource availability. The subset of schools we visited during our qualitative data collection were socio-demographically representative of the whole. Participating schools offered PE and extracurricular fitness activities, but outdoor recess was much less common.

The AHPC teachers were the primary coordinators and facilitators for AHPC, and their management role was confirmed by survey responses, interviews and focus groups, and our observations during site visits. They coordinated technology deployment and management, encouraged students to increase their activity, and connected the largest number of stakeholders.

Student selection favored the more proactive and responsible students (and those with proactive parents), either through explicit selection by teachers, or by their responsiveness in returning permission slips. This may have affected the high level of initial motivation and enthusiasm noted by teachers and reflected in student surveys. Teachers believed students increased their physical activities and tried out new ways to be active, but the AHPC also appeared to exhibit a strong novelty effect, confirmed by the longitudinal analysis in the 'Physical Activities & Motivation' section of this report.

The school environment presented several barriers to the AHPC. Teachers reported technological glitches, schedule changes across the three heats, and changing weather conditions as discouraging factors. Our qualitative analysis backs up these claims and adds other reasons: slow computers made accessing the AHPC site more difficult, and limited or low-quality gym access inhibited some schools. Our qualitative analysis also identified another challenge: limited time in the students' daily schedules. Students' limited unstructured recess during school and full schedules after school restricted the possibilities for additional AHPC-related rituals or activities.

Students generally received good social support for physical activity, with peers joining them in exercise and parents and teachers encouraging them. This level of social support appeared to increase from heat to heat, but we believe this is a side effect of the schools with less social support dropping out of the program.

The teacher plays a critical role in supporting the program within a given school. Teachers in the Challenge provided structured opportunities for additional physical activity, such as building walking into their class lessons, organizing after-school intramural competitions, or getting students access to the school gym at times in which they normally would not be able to use it. The teachers also became stewards of the pedometers, and mediators between the school, the students, and Humana.

We found that teachers were most successful in managing the game when they had support from their school administration to include physical activities into their lesson plans, when all children in the

challenge were grouped into one or two classes, and when the teacher had students in the same classes across all of the semesters in the program.

The Game, Website, and Technology

In this section, we discuss findings concerning the game itself and present a usability analysis of the website and technology used in implementing the game.

The AHPC Game

The AHPC was designed to encourage students to be more physically active and to enjoy the process of the Challenge. Earlier, we reported that the students gained significantly more steps during the three heats than the pre-game period. This finding suggested that the AHPC did encourage the students to be more active. In this chapter, we focus on analyzing how the students participated in the AHPC, and how the AHPC was received and integrated in their daily lives. From the survey analysis, we learned that the majority of the students who experienced other pedometer-based school programs evaluated that the AHPC to be better, but they also reported a few playability problems. To understand further about where these opinions came from, we report our findings along the following two major themes: "pervasive game and free-form play" and "pre-teen players: enthusiasm and drifting interest".

PERVASIVE GAME AND FREE FORM PLAY

Salen and Zimmerman (2004) differentiated the two concepts of games and play. A "game" is a system in which players engage in an artificial conflict, defined by rules that result in a quantifiable outcome. "Play" is free movement within a rigid structure. When analyzing the data, we found that advantage of the AHPC lies in the emergent behaviors ("play") that its loose structure ("game") afforded. The following two sections focus on how the design of the AHPC system affected the experience; the third section discusses the practices that participants adopted to engage in the AHPC.

The difference between the AHPC and other exercise video games

Generally, video games include the key elements of decision-making, goals, opposition, managing resources, game tokens, and information (Costikyan, 2002). The AHPC had all these six elements, but we found that the students did not often refer to the AHPC as a game during the focus groups or interviews. The essential difference was whether the goal of the game was to keep the players' attention in the

video game world or the real world. The following analysis showed that the AHPC facilitated the interaction more in the real world than in the video game world.

High percentages (71%) of students play video games on a daily basis according to our survey. Some compared the AHPC with other games during the focus group, and below is one example:

> *Participant_2_boy: I don't like it [the AHPC] because it's just walking. I mean you can do running, but it's mainly walking.*
>
> *Interviewer: Well, if you want to change it, what kind of changes would you make?*
>
> *Participant_2_boy: I have this Wii game where I can do a lot of running, jumping and I'm timing myself.*

In this example, the student believed that the sports game on the Wii console provided more activity options. From a technical point of view, the Wii system does not understand the gesture of a player. Instead, it projects the input data (players' movements) to the avatar and gives on-screen visual cues. Comparatively, in the AHPC the steps are abstract numbers. There is no one-to-one visual mapping between a participant's action and the horse's action. A second difference is the immediacy of the feedback. Modern video games always provide moment-to-moment feedback to the players. However, in the AHPC there is a gap between the input (e.g. running, walking) and the output (e.g., the change in steps for the individual and school). It took eight hours for new steps to appear in the web record. Thus, the locations where the input happened (e.g. playground, school gym)--and when it happened--and output (e.g. the computer screen in the classroom or at home) were disconnected. A third difference is the avatar control. Although customizing the horse was thought to be fun by many students, it was detached from the main goal (from the kids' perspective) of the game (getting steps), making it hard to maintain interest in the video game.

From the survey, we found that the within website communication, including functions of status update, checking other participants' horses, and checking other schools' horses, were not frequently used. Two students compared the social interactions in Club Penguin, an online multiplayer game for kids.

> *Participant 1: It (Club Penguin) is a game. You are a little penguin and you go to places to talk with like different people*
>
> *Participant 2: And you can meet them and see what they're like and –*
>
> *Participant 1: And you could play around, play games against them.*

In Club Penguin, the players are represented by their avatar, and the game space becomes a social location where players can hang out through their avatars. However, in the AHPC, such social presence and space was not supported within the game interface.

The above analysis showed that the AHPC is not a traditional video game. Instead, it belongs to a new genre of pervasive games, as discussed in the following section.

The AHPC as a pervasive game

Unlike video games that may require a game console, handheld device or a personal computer, the AHPC does not rely on using a computing device. The system was set up to upload the steps automatically so that the kids could contribute to their school's progress without spending time on computers. This flexibility was especially important because the teachers reported that many of the students did not have daily access to the Internet at school or home due to the limited school funding and relatively low socio-economic status of the families. In addition, the majority of the schools we visited did not allow the students to bring cell phones or handheld computing devices to school.

The pedometer was the key element that collected the step data in the field. We will discuss the usability of the pedometer in the next section. Here we focus on the playability and how to improve its design. The current Actiped pedometers did not perform robustly. By the end of the AHPC deployment, about two-thirds of the step data were not properly logged. The students realized this problem (one-third rated the Actiped pedometers as "not accurate") and got frustrated because their effort was "*wasted*". This issue was brought up the most frequently during the focus group, and it strongly influenced the kids' engagement with and trust of the system. Another issue with the pedometer was its "form factor". The black, circular device with no display did not afford playability or imagination. The form factor constrained the pedometer to be a tool that the students had to wear, rather than a toy with which they could interact.

In her thesis, McGonigal (2006) defines games to be "performance-based interventions that use game imagery to disrupt the normative conventions of public spaces and private technologies" (p. 3). If we use the usability engineering criteria to evaluate the AHPC, the gulf of evaluation and execution needs to be improved (Norman, 2002). However, we argue that the value of the AHPC system lies in its pervasiveness and the flexible and loose structure. This genre of games needs to be further studied to

establish an evaluation system. In the following section, we present our findings on how pervasive games are played.

Free form play

In the game research domain, the magic circle is defined as a sacred time and space specifically designated to playing games. However, when children engage in activities related to the AHPC, the boundary of the magic circle is blurred. The physical activities that these kids create and can be taken as play are highly varied and include walking the dog, shopping with their family, running laps with classmates, and doing chores around the house. Many of these actions were not normally taken as exercise, but the AHPC gave the students a lens to rethink their daily activities as ways of getting points for the Challenge. The following example showed the effect of this lens:

> *I felt kind of weird because when I would walk somewhere I would think I'd get steps. 'Cause I would think I was still in school and I'd walk somewhere. Like I'd go to see my grandma and I'd walk there and think, 'Oh, I'm just gonna go to school, scan my foot steps and I realized I didn't have my pedometer on.*

This boy described his experience during the winter break when the AHPC was not being played and the pedometers were kept in school. He kept the habit of viewing the activity ("walk to see his grandma") as points even without wearing the pedometer.

This change also affected the social group around the students. Below is an example showing how parents persuaded students to do certain things by reminding them about the AHPC.

> *Sometimes my mom's like, 'Come shopping with me. If you walk around the stores for like three hours then you can get more steps.' So we're just walkin' around the stores, just stop and shop for three hours.*

The girl also told us that she did not like shopping herself, but she still been persuaded by her mom to do this activity because of the AHPC. This approach is also used by other pervasive games, such as Foursquare (Worthham, 2010), a social networking service that encourage exploring and sharing the information of a city. The more pictures and information a user shares, the more points they get from the system. The social interaction among friends enforces thinking about the real world as a game field to get more points.

Besides the efforts from students, teachers also incorporated the AHPC into their school schedule. The flexible and loose structure of the game was creatively integrated into the relatively rigid daily schedule of the students. From the site visits, we saw and heard a few such stories. Below is one example in which a teacher at School 66 combined a history class with getting steps for the AHPC:

> *It was – that last quarter mile, they were being – we were reenacting Pickett's Charge and they were being shot at. So, of course, not really, but they were imagining it, 'cause we've been studying the Battle of Gettysburg. So, that last lap, our field is a quarter mile, the last lap, they were so cute, they'd like fall down and then, they'd get up, but they'd be wounded and so, they'd be dragging. It was – I should have videotaped that. It was very cute… But we put on – everybody put on a mile that day… Yeah, the kids were looking at their steps and said, oh, that's the day we went outside.*

This teacher creatively merged the educational goal of civil war history and the AHPC. She led the students to role-play the scene from an important event they learned in class, gained more steps for the AHPC, and created a good memory for the group to share. This was not an isolated incident. Other teachers also formed their own practices based on their experience and the subject they taught. For example, in School 38, the PE teacher embedded an everyday ritual in her PE seminar: The whole class (including the AHPC and non-AHPC participants) checked the steps and rank of the school on a projected display. At the same time, the AHPC students walked in circles within the classroom to use every minute to get more steps. In School 51, the math teacher, who was a former basketball coach, decided to motivate the kids by creating a within group competition. He “hired” and “fired” participants according to their performance in the Challenge. The pedometer did not belong to one student; instead, only students who did well were qualified to wear it. In School 1, the math teacher took 20 minutes from her one and half an hour-long class, and brought her students to the gym, where she obtained extra access time because she and the PE teacher had a good partnership. Her students taped the worksheet on the gym wall, and mixed running, rope jumping, and solving math problems together. At the end of the exercise, those who got their worksheet done correctly received applause from the class. We were impressed by the creative practices that these teachers were able to pull together. There are some commonalities among these examples. First, compared to the relatively rigid school schedule, the teachers had some flexibility to customize their classes so that the kids could engage in more physical activity. Second, these teachers believed in the importance of physical activity in children’s development. Third, the teachers were good at motivating the students.

This kind of free-form play also appeared among the students themselves. They created mini-games, competitions, and self-organized group activities. Here is one example in which a student competed with her friend who was also in the AHPC:

> *Sometimes when – last year, last spring, when we did the Horsepower Challenge, me and my friend, we would always brag about who had more steps at the end of the day. So at the end of the day, we'd call each other and go on the Internet and see how many steps we got, and whoever got the most had to pay the other $1.00.*

Debord et al (1960) wrote, "Play, radically broken from a confined ludic (entertaining) time and space, must invade the whole of life" (no page number). In the AHPC, we not only witnessed such an "invasion", but also analyzed how it happened under certain constraints of the environment.

PRETEEN PLAYERS: ENTHUSIASM AND DRIFTING INTEREST

The age range of 10-13 was recently identified as a unique group of players by the game industry. This age range was named the "age of obsession", because children at this age start to get quite passionate about their interests (Schell, 2008). Does this stereotype also apply to the AHPC participants? From the data, we found that the students were enthusiastic about the Challenge at the beginning, but interest drifted for various reasons.

Enthusiasm about the AHPC

From the site visits and the surveys, we found that the students were very enthusiastic about the AHPC, especially at the beginning of the Challenge. Many teachers talked about this enthusiasm in the interviews. The following example shows that the students did extra-curricular activities to get more steps, and even the students who did not participate in the AHPC were interested:

> *In had a lot of students asking me to participate in the Horsepower Challenge. I wish I could have taken on more students. Even the 7th graders wanted to get in on the competition and they were interested in watching our progress. I think the students became more physically active and were interested in staying after school to get 'more steps!' They wanted to exercise even more!*

The majority of the participants were between 11 and 13. In this age group, they start to demonstrate intrinsic motivation, self-imposed goals, and active engagement. Some teachers believed that being able to get the extra energy out was one of the positive effects of the AHPC.

> *You hear a lot of, 'Oh, well, these kids have ADHD. They have ADD. They have…'And I don't particularly have the same beliefs as a lot of people in that I think children are children and they need to be physical. They need to run. They need to develop physically. They need to develop*

> *emotionally and psychologically and the whole bit, but they have to be able to run around. They have to be able to get the energy out.*

Some students became "over devoted" to the game, although these cases did not happen frequently. One student mentioned that checking the AHPC was becoming too much of a burden for him because he constantly wanted to login the website and see the rank of his school. Another example is the case of two students who spent so much time outdoors after school that their parents started to get concerned about their safety. One parent took her kid's pedometer back to school and removed her out of the Challenge. These extreme examples demonstrate the amount of passion that these preteen students can bring to the competition. The safety of play is an important concern for any challenge designed to encourage real world behavior change (Rubin, Fein, & Vandenberg, 1983).

Fading enthusiasm over time

In the step analysis, we found that for the small set of students who participated in the Challenge for all three heats, the number of steps they logged dropped significantly over time. It could be partially explained by the seasonal difference. We compared the difference between the steps of participants who joined during the first heat and the second heat and found that the latter group had significantly more steps than the first group in the second heat. This finding indicates that the students were not maintaining their enthusiasm over time. The novelty effect was discussed in the teacher's survey, and they mentioned technical glitches, schedule change and seasonal differences as factors that affected student interest in the AHPC. During the school visits, we asked the students about whether they were going to continue to be physically active after the Challenge ended. More students answered no than yes. This phenomenon might be related to the specific age group of the participants. The following quotes from a teacher we interviewed touch on this:

> *Teacher: A lot of the kids, they enjoy going online and customizing their avatar. They enjoy that aspect. But we live in a world where like, technology is just so – it's running rampant. So if you can't keep up with the kids, their attention span is like, 'Oh, we'll just do this.' They're quick to put that down and go on to the next thing that offers more .So it's kind of like you're fighting that force, like you have to compete with Sony and Microsoft.*
>
> *Interviewer: Right, so you need to be able to grab their attention.*
>
> *Teacher: and not just grab it but keep it. Like, yeah, you have to grab it and then a buddy of mine told me every nine minutes, a kid, you have to do something different 'cause their attention span is so short*

As described by this teacher, the short attention span of the students suggests that the feedback given by the system needs to be almost continuous. The AHPC sets up the goal for a school to win, but this goal is months away from the daily effort. The incentive structure of the game needs to be adjusted to support both short-term and long-term goals.

AHPC Usability Analysis

As part of our site visits, we observed students using the website and pedometer. As part of our qualitative analysis, we combined these observations, interviews, and focus group discussions with our own heuristic evaluation to generate a usability analysis of AHPC.

WEBSITE USABILITY

While visiting schools and watching participants walk us through the Horsepower Challenge website, we observed several common challenges in the current version of the game. From a usability perspective, participants reported difficulties with the sign-in page, the track, and the teacher view. We also noted that several features introduced in the new version of the game were under-utilized. It is important to note here that the interface appeared to generally succeed at its core goals of showing students their personal steps and their school's position in the race, letting them interact with their avatars, and serving as a desired online activity. What follows are areas in which the students and teachers we spoke to felt the game could improve.

Sign-in

The sign-in page presented several username/password recovery methods, but we spoke to students who had both forgotten their usernames *and* lost their Actipeds. In addition, teachers complained that as the students could select their own username and password (in the updated version of the game) there was nothing the teacher could do if the students then forgot what these were. Some of the teachers therefore preferred assigned usernames. A best practice in this situation would be to give teachers more administration privileges, or at least give them access to a list of student usernames.

Track

The new track system introduced in 2009 has made it more difficult to quickly assess relative positions of teams. Because school busses can "lap" each other, the only way to know how each school is doing relative to one's own is to move the mouse over each bus. Additionally, because only a few busses were radically customized, it is not possible to know from merely looking at a given bus to which school it belonged. These issues suggest that a simpler, linear track would improve usability and allow for easy visual scanning of the competition.

Status

The status indicator ("quote bubble") feature has a lot of potential to create a 'social stream' and keep students coming back to the game, but tucked in the bottom-right corner, it was easy to ignore. It was also unclear to students who exactly could see their status updates; some assumed these could only be seen by their classmates. A more visible status display area would also help another under-utilized feature: ribbons. Students recognized what these were for, but we did not meet a single student who was actively *proud* of his or her ribbon. Increasing the social visibility of ribbons would also increase their perceived worth.

Customization

Students universally enjoyed the ability to customize the horses and seemed to easily connect their physical activity to the amount of in-game currency they earned. However, the store's implausible return policy meant that there were no real penalties to the choices they made, and after they had banked a certain number of steps, no customization-based incentive to continue accumulating steps. We believe that the customization feature could be much more effective if goods were non-returnable or at least subject to a hefty 're-stocking' fee.

Teacher view

Almost all the teachers we met reported a desire for more monitoring and administration control within the game. Several claimed they used to be able to see a more granular view of student steps; whether this is actually true, it represents a legitimate desire to be more informed about the progress of individual students. Teachers also reported that the voting process was not as easy to use as they would have liked.

System requirements

Finally, a note about system requirements: Several participants noted that the newer version of the game, in its increased complexity, also introduced lag and loading delays. We observed this first-hand during our student interviews. Many of these schools have old computers with low-resolution displays (e.g. 800 x 600). This meant that students often could not see the entire game user interface at once, or that they would have to wait for it to load. This presents a design challenge for future iterations of Horsepower Challenge: Maintaining fun and interactivity while decreasing load times and accommodating older hardware.

PEDOMETER USABILITY

Generally, participants (students and teachers alike) reported high levels of satisfaction with the Actipeds—when they worked. Every teacher we spoke to reported having dealt with at least one broken pedometer, and in our teacher interviews, teachers often brought up the subject of broken pedometers as their biggest frustration. When we queried this in more depth, teachers' biggest concern was not that the pedometers malfunctioned—this is to be expected in any large-scale deployment. Their primary concern appears to be *time to resolution*. This suggests prioritizing features that could aid in malfunction detection, as well as a continuing attention to prompt replacement of broken units.

Display

One of the contributing factors to delays in malfunction detection is the lack of step-count display on the Actipeds. A concerned student who noticed their step-count not increasing or saw the display go blank could immediately report a malfunction to their teacher. Instead, the current system requires the student or teacher to notice that steps are not being uploaded to the server, an issue that could be caused by a faulty pedometer *or* a faulty connection to the server. However, desire for a display was not universal. Some teachers praised the lack of a display for its' motivational effects: Students, they theorized, were less likely to become complacent as soon as they reached a daily goal if they were unsure whether they had met their goals yet. The lack of display was also seen as an anti-cheating feature, since it was much more difficult to assess the relative effectiveness of cheating strategies without immediate feedback.

Form factor

Many students praised the foot-mounted form factor of the Actipeds. Students who had worn waist-mounted low-cost pedometers before were especially grateful for the pedometers' silence and unobtrusiveness. However, the clip mechanism did cause some difficulties, particularly for students wearing flip-flops, boots or other non-lacing shoes. This required students to adopt creative mounting strategies such as tucking the Actiped into their socks. The fastening mechanism was also reported to have contributed to the Actipeds easily getting lost, as the students were using it in physical activities without it being properly fastened to laces.

Summary

In this chapter, we analyzed the usability and playability of the website and technology of the AHPC system, based on survey and site visit data.

Unlike traditional video games, AHPC intertwines interactions on the computer screen with the real world. Moreover, the free-form and self-organized activities created by the students and teachers distinguish the AHPC from other video games. Our results suggest that while AHPC provides a platform for encouraging children to be more excited about physical activity, the system as currently implemented does not always sustain the interest of the children over three semesters. In order to sustain long-term interest, we especially recommend simplifying the website, and providing clarity to how step-counts are recorded by the game, so that students are not disappointed by perceived inaccuracies of the game.

Conclusions: AHPC as a Tool for Improving Health-Related Behaviors

The findings of the surveys in each of the three heats paints a portrait of students as being generally very physically active and having a positive view of physical activity and a good self-image. The students seemed to have a positive view of physical education classes and the majority plays some sport. Their self-report indicated a very high general physical activity level and most consider themselves at least as or more active than their peers. From the step data collected with the Actipeds, we found that the children enrolled in AHPC did increase their physical activity compared to the baseline period in all three heats, even if the number of steps did decline in the course of the three heats. We did not find corresponding evidence of increased physical activity level in the survey data and in fact we did see a decrease in positive attitudes towards being physically active in the course of the Challenge. However, when asked about participating in the AHPC the students stated that they had tried doing more new activities in the course of the Challenge and enjoyed participating in the AHPC.

In the results documented in this report we found a few aspects surprising and worthy of further discussion. Additionally, we want to highlight some findings which we believe are highly relevant to future considerations of designing and deploying a large scale health initiative like the AHPC.

Sustaining Long-Term Interest and Enthusiasm

Due to issues with identifying students and retention of AHPC participants across the three heats, we were not able to do a comprehensive longitudinal analysis throughout the three heats. Instead, we opted to do two longitudinal analyses, the first phase spanned the first and second heat, and the second phase spanned the second and third. This allowed us to analyze longitudinal data for more participants.

The results of the longitudinal analyses did not yield any differences in terms of self-reported behavior; the students seemed to stay similarly active throughout the three heats. However, when the steps count of the students who participated in all three heats was investigated it turned out that their steps decreased over time, although students had more steps in each of the heats than the baseline data. In addition, the longitudinal analyses of the survey data did show a lessening enthusiasm for being

physically active as time passed and the students reported physical education classes being more difficult in the spring 2010 as compared to the fall 2009.

The decreased enthusiasm for being physically active was also evident when the survey responses of the three heats were compared; specifically the students reported being more often too tired or too busy to exercise as the AHPC continued and they reported disliking physical activity more. This could be due to increased curriculum pressure with age, lessened enthusiasm for (and as a result less prioritization of) physical activities, or both. We did find however that more students reported getting something out of being physically active and that it gives them a strong feeling of success in the second heat as compared to the first one.

We found a drop in family support for being physically active between the first and second heats, both in terms of family members joining the students in doing physical activities and encouraging them to be active. A possible reason for this is that the excitement about joining the AHPC in the beginning translated into more participation and encouragement from family members, but as the AHPC continued the novelty and enthusiasm dropped off along with family involvement. The opposite pattern of results was found for the support of their teacher; the students reported more social support from teacher as the AHPC progressed. One reason for this could be that as the AHPC continued the teachers enthusiastic about the AHPC stayed in the program (as more schools dropped out of the Challenge with each heat), and this teacher involvement is represented by a general encouragement to the students to also keep participating.

It is impossible to say whether decrease in steps and enthusiasm for physical activities was due to the students losing interest in being physically active as they age, or losing interest in playing the AHPC, seasonal changes, or all of these things. Research has suggested that kids tend to lose interest in physical activities at this age, but we also found evidence of a novelty effect (that is, more enthusiasm for participating in the AHPC at the start of participation). It is therefore difficult to get at the exact reasons for these findings, but they do suggest that deploying an intervention like the AHPC over time represents some challenges for sustaining long-term interest and enthusiasm.

The results suggest a few possible factors that might play an important role in this context. First, it seems that the prize money given to the winning school was both a boon and a curse: On the positive side, it seems to have motivated teachers to become more involved with the Challenge (and we found teacher involvement to be an important motivator and determinant of success). On the negative side,

the possibility of winning the prize money might have encouraged the teachers or administrators to select students who were already very active physically, and therefore unlikely to benefit much from an initiative like the AHPC. Anecdotally, our experience in the site visits suggested that the biggest advantage of the program was to include students who are not already on a sports team or physically active.

Second, for the teachers who were originally enthusiastic about the AHPC, maintaining their own and students' enthusiasm was difficult in the face of repeated problems with the technology involved. Our findings suggest that the biggest problem was due to steps not being logged accurately (or at all). According to the teachers, nothing killed student enthusiasm faster than if the steps the students had worked at accumulating were not logged (for example due to malfunction in the Actiped). In addition, if the teacher was faced with having to spend time and effort solving technology problems (e.g. replacing Actipeds, getting the remote access point to work, or troubleshooting access to the AHPC website) their enthusiasm for participating decreased.

Third, the integration of the AHPC into the school's schedule and culture seems to have been rather haphazard and mostly left to the teachers themselves to figure out. The success of implementing the AHPC in the schools was therefore dependent on the teacher's enthusiasm and ingenuity in integrating the Challenge into the schedule and creating opportunities for the students to accumulate steps and be motivated by participating. In future implementation, it might be a good idea to provide the teachers with suggestions of how the AHPC could be included inside and outside the classroom. A related issue is that the AHPC as such does not impose any specific events on participants; it's up to them to get steps and log onto the website. This is a great contrast to the highly scheduled day most of the middle school students seem to have, and it might be difficult for them to focus on the AHPC when faced with a tightly scheduled events and deadlines most of the time. At least, it might create a higher threshold for participation, as the students have to be especially enthusiastic to create the time and space to participate. Here again, helping teachers integrate the Challenge into their schedule could be the solution.

Fourth, the motivation for participation built into the game might not have been enough to sustain enthusiasm over time. Emphasizing competition between schools for the prize money over a long period of time might be a difficult goal as teachers and administrators have other priorities in the course of the school year. Also, changing the appearance of the horse avatar did not seem to be very successful

motivation for participation generally (see below), and there is little reason to believe this acted as a motivation for participation long-term. Finally, the online game interface did not include a social component which might have acted as a long-term motivation as it could have fostered a sense of community and team spirit over time.

Altering Game Economics and Leveraging Social Comparison

Social comparison is the idea that students are motivated by the desire to 'pull their weight', that the AHPC leverages peer pressure mechanics for increased physical activity. In our focus groups and interviews, we found little evidence to support social comparison as a primary motivator. Tellingly, students rarely reported checking up on each others' step-counts, an activity which ought to be commonplace if social comparison was acting as a primary motivator. However, we did observe instances of social comparison during the focus groups, although rarely based on actual step-counts. At one school, for example, several of the boys reported feeling that they were responsible for a large number of the school's steps. Several girls responded that it was not true, and noted the unfairness of the comparison, since most girls' sports were out of season at the time. In this case, peers had been comparing themselves to each other, but as we found repeatedly, the focus was on relative ability to contribute to the inter-school competition, rather than strict local social comparison. This conclusion was supported by statements from teachers saying that the sense of being a part of a team was important motivator for the students, especially ones not otherwise involved in team sports. Also, generally our findings indicated the students enjoyed the school competition aspect and took their responsibility of competing for the school seriously (at least initially).

The customization of horse avatars could potentially be a motivating factor, as the ability to purchase new 'bling' was tied to the number of steps a student took. However, the limited peer visibility and the lax 'return policy' on outfits and patterns meant that although students enjoyed customizing their horses, this activity did not form a central motivator. We never heard, for example, a student reporting that he wanted to get more steps in order to "buy" more outfits or apparel. Often, students would report that they were 'saving up' for an expensive item, but rarely described this as their primary incentive to get more steps.

We saw a correlation between logging into the website and activity level, however it's not clear what role the website itself plays in increasing activity levels. One possible reason is that the students did not

get any feedback on the number of steps they had accumulated from the Actipeds, and had to rely on getting feedback from the website. The more motivated students might have therefore both logged more steps and visited the website more frequently to check on their progress or checking feedback more often might have encouraged them to try to get more steps. Future research should examine the role of the website in more depth and specifically which aspects motivate the students (e.g., getting feedback about their steps or getting feedback on school progress).

Weekly Activity Level - Targeted interventions for weekends

On a shorter time scale we found that most students were generally very physically active according to the survey results. The majority of participants played or practiced sports many times a week, and reported walking, running, playing sports, playing outside, playing active games, and doing chores at least weekly in the course of all three heats.

Given these findings we found it interesting to observe a trend that step counts decreased during the weekends. Either the students tended to be less active during the weekends as compared to the weekdays or they did not wear their pedometers as consistently.

The first explanation suggests that the students have fewer opportunities for the kinds of structured physical activities that school environments provide. We generally found the schools provided ample opportunities of different variety (e.g., physical education classes, recess, sport participation, and other extra-curricular activities) for the students to be physically active. In addition attending school provides plenty of opportunity for the students to engage in unstructured activities with their peers. These opportunities for being physically active are less likely to be present during the weekends and students have to be either internally motivated to be active or have parents that get them to be active. We found that parents tended to verbally encourage their kids to be physically active (or support them by transporting them), but were less likely to join the kids for physical activities. These factors in tandem suggest that structure of physical activities and opportunities for being physically active play an important role, and there might be a way for future interventions to target weekend activity levels specifically.

It has to be noted that the second explanation, students not wearing their pedometers as consistently during weekends, presents a problem for this interpretation and would need to be addressed if the goal was to address weekend activity levels.

Gender

We found gender differences on many occasions; generally boys portrait themselves as more physically active than girls in that they both characterize their general activity level as higher than girls do, they report practicing sports more often, and they report doing strenuous and moderate exercises for at least 15 minutes more often during the week than girls do. Gender differences were also present in the type of physical activities the students reported doing, girls were more likely to dance, cheerlead, and do indoor chores, whereas boys were more likely to lift weights, do outdoor chores, skateboard, or play football, Wii or DDR, or ball games.

Gender differences were also present in the attitudes and feelings towards being physically active. Girls rated physical activities, physical education classes, and how they felt when physically active more negatively than boys.

We do not know whether these gender differences reflect a genuine difference in physical activity levels between girls and boys at this age, or if they reflect differences in how the genders describe themselves on self-report. As we did not have gender associated with the login names, we could not analyze the step data to investigate these hypotheses, but either way, it might be worthwhile to deliberate how an intervention like the AHPC can specifically address the needs and attitudes of girls. For example, girls might need a different emphasis in terms of the activities done to accumulate steps or their motivation for participating in the Challenge might be based on different premises than for the boys.

Summary

In conclusion, children enrolled in American Horsepower Challenge increased their physical activity above what was seen in the baseline period and students who participated in the AHPC had a general positive attitude towards being physically active, even though no change in self-reported physical activity level was found. Teachers reported that AHPC was at least as good as or better than other pedometer programs, but we do not have any objective data showing *how* AHPC is better when it comes to health outcomes.

However, our site visit data are highly suggestive. AHPC is unique in its use of school pride and elementary game mechanics to motivate kids to get more everyday exercise, and these appear to be

powerful techniques when AHPC works well. A committed teacher can use AHPC to overcome traditional barriers of time and gym access, and as a vehicle for everyday health rituals.

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